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**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of:

Charles P. Jenrick et al.

Atty Dkt: 47171-00246USP1

Serial No.: 09/688,526

Group Art: 3652

Filed: October 16, 2000

Examiner: not assigned

Title: CURRENCY HANDLING  
SYSTEM HAVING MULTIPLE  
OUTPUT RECEPTACLES

**PRELIMINARY AMENDMENT "B"**

COMMISSIONER FOR PATENTS  
WASHINGTON, D.C. 20231

**CERTIFICATE OF MAILING**  
37 C.F.R. 1.8

I hereby certify that this correspondence is being deposited with the U.S. Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, Washington, D.C. 20231 on the date indicated below:

April 29, 2002  
Date

*Adrienne White*  
Adrienne White

Dear Commissioner:

Prior to the examination of the above-captioned patent applications, Applicants respectfully request that this Preliminary Amendment "B" be entered.

**IN THE CLAIMS:**

Please amend claims 1, 13, 17, 36 and 64 as follows:

1. (Amended) A currency handling device for rapidly processing a plurality of currency bills, the device comprising:

an input receptacle adapted to receive stacks of bills to be processed;

a plurality of output receptacles adapted to receive the bills after the bills have been evaluated, at least one of the output receptacles including a holding area and a storage area;

a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle into the holding areas;

an evaluating unit adapted to determine information concerning the bills, the evaluation unit including at least one evaluating sensor positioned along the transport path between the input receptacle and the plurality of output receptacles;

a plurality of bill passage sensors sequentially disposed along the transport path, each of the plurality of sensors being adapted to detect the passage of a bill as each bill is transported past each sensor; and

a controller being adapted to track the movement of bills along the transport path, the controller adapted to separately maintain a count of the number of bills transported to each of the holding areas and each of the storage areas, the controller being adapted to detect the presence of a bill jam and suspend operation of the transport mechanism when a bill is not transported past one of the plurality of bill passage sensors within a predetermined amount of time.

13. (Amended) The currency handling device of claim 1 wherein the device is adapted to process bills at a rate of at least about 1500 bills per minute.

17. (Amended) A currency handling device for rapidly processing a plurality of currency bills, the device comprising:

an input receptacle adapted to receive stacks of bills to be processed;

a plurality of output receptacles adapted to receive the bills after the bills have been evaluated, at least two of the output receptacles including a holding area and a storage area;

a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle into the holding areas;

an evaluating unit adapted to determine information concerning the bills, the evaluation unit including at least one evaluating sensor positioned along the transport path between the input receptacle and the plurality of output receptacles;

a plurality of bill passage sensors sequentially disposed along the transport path, each of the plurality of sensors being adapted to detect the passage of a bill as each bill is transported past each sensor;

an encoder adapted to produce an encoder count for each incremental movement of the transport mechanism; and

a controller being adapted to track the movement of bills along the transport path, the controller adapted to separately maintain a count of the number of bills transported to each of the holding areas and each of the storage areas, the controller being adapted to detect the presence of a bill jam and suspend operation of the transport mechanism when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts.



36. (Amended) The method of claim 35 further comprising resetting the count of the total number of bills transported into each of the holding areas.

64. (Amended) The [currency handling device] method of claim 50 further comprising:

reversing the face orientation of a bill where the face orientation of a bill does not match a target orientation with a bill facing mechanism;

sequentially disposing a plurality of bill passage sensors along the bill facing mechanism; and

detecting the presence of a bill jam in the bill facing mechanism when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts.

#### REMARKS

Claims 1-64 are pending in the present application. Claims 1, 13, 17, 36 and 64 have been amended to correct obvious typographical errors contained in the application as originally filed. In accordance with current practice under 37 C.F.R. § 1.121, a clean version of the pending claims is attached and captioned as "Cleans Version Of Pending Claims Incorporating Amendments Made Pursuant To Preliminary Amendment 'B'."

If there are any matters which may be resolved or clarified through a telephone interview, the Examiner is respectfully requested to contact Applicants' undersigned attorney at the number indicated.

It is believed that no fee is presently due; however, should any additional fees be required (except for payment of the issue fee), the Commissioner is authorized to deduct the fees from Jenkins & Gilchrist, P.C. Deposit Account No. 10-0447, Order No. 47171-00246USP1.

Respectfully submitted,

Date: April 29, 2002



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**CLEAN VERSION OF PENDING CLAIMS INCORPORATING  
AMENDMENTS MADE PURSUANT TO PRELIMINARY AMENDMENT "B"**

1. (Amended) A currency handling device for rapidly processing a plurality of currency bills, the device comprising:
  - an input receptacle adapted to receive stacks of bills to be processed;
  - a plurality of output receptacles adapted to receive the bills after the bills have been evaluated, at least one of the output receptacles including a holding area and a storage area;
  - a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle into the holding areas;
  - an evaluating unit adapted to determine information concerning the bills, the evaluation unit including at least one evaluating sensor positioned along the transport path between the input receptacle and the plurality of output receptacles;
  - a plurality of bill passage sensors sequentially disposed along the transport path, each of the plurality of sensors being adapted to detect the passage of a bill as each bill is transported past each sensor; and
  - a controller being adapted to track the movement of bills along the transport path, the controller adapted to separately maintain a count of the number of bills transported to the each of the holding areas and each of the storage areas, the controller being adapted to detect the presence of a bill jam and suspend operation of the transport mechanism when a bill is not transported past one of the plurality of bill passage sensors within a predetermined amount of time.
2. The currency handling device of claim 1 wherein the controller is adapted to cause the bills in each of the holding areas to be moved to the corresponding storage area after detection of a bill jam.
3. The currency handling device of claim 2 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller adapted to prompt the user for input before causing the bills in each of the holding areas to be moved to the corresponding storage areas after a bill jam is detected, the controller adapted move the bills in the holding areas to the corresponding storage areas in response to user input.

4. The currency handling device of claim 2 wherein the controller is adapted to update the count of the number of bills transported into a storage area by adding thereto the count of the number of bills transported into the corresponding holding area prior to causing the bills in the holding area to be moved to the corresponding storage area.
5. The currency handling device of claim 4 wherein the controller is adapted to reset the count of the number of bills transported into the holding area after causing the bills in each of the holding areas to be moved to the corresponding storage area.
6. The currency handling device of claim 2 wherein the controller is adapted to cause the transport mechanism to flush the bills from the transport path after the bills in each of the holding areas are moved to the corresponding storage areas.
7. The currency handling device of claim 6 further comprising a user interface adapted to receive input from a user of the currency handling device, wherein the controller is adapted to prompt the user as whether to flush the bills, the controller being adapted to cause the transport mechanism to flush the bills in response to user input.
8. The currency handling device of claim 2 wherein the controller is adapted to detect the presence of a bill jam in the holding areas, the controller adapted to suspend operation of the transport mechanism upon the detection of a bill jam in one of the holding areas, the controller being adapted to cause the bills in each of the holding areas not having a bill jam detected therein to be moved to the corresponding storage areas upon detection of a bill jam.
9. The currency handling device of claim 8 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller adapted to prompt the user for input before causing the bills in each of the holding areas not having a bill jam detected therein to the corresponding storage areas, the controller adapted move the bills in each of the holding areas not having bill jams detected therein to the corresponding storage areas in response to user input.
10. The currency handling device of claim 9 wherein the controller is adapted to prompt the user as whether to flush the bills, the controller being adapted cause the transportation mechanism to flush the bills in response to user input.

11. The currency handling device of claim 9 wherein the controller is adapted to electronically jog the transport mechanism to facilitate the clearing of the bill jam in response to user input via the user interface.
12. The currency handling device of claim 1 wherein the device is adapted to process bills at a rate of at least about 800 bills per minute.
13. (Amended) The currency handling device of claim 1 wherein the device is adapted to process bills at a rate of at least about 1500 bills per minute.
14. The currency handling device of claim 1 wherein each of the output receptacles including a holding area and a storage area further include a paddle adapted to move the bills from the holding area to the corresponding storage areas.
15. The currency handling device of claim 1 further comprising:
  - a bill facing mechanism disposed along the transport path between the evaluation region and the plurality of output receptacles, the bill facing mechanism being adapted to rotate a bill approximately 180°;
  - a plurality of bill passage sensors sequentially disposed along the bill facing mechanism; and
  - wherein the controller is adapted to detect a bill jam within the bill facing mechanism.
16. The currency handling device of claim 1 further comprising an encoder adapted to generate an encoder count for each incremental movement of the transport mechanism.
17. (Amended) A currency handling device for rapidly processing a plurality of currency bills, the device comprising:
  - an input receptacle adapted to receive stacks of bills to be processed;
  - a plurality of output receptacles adapted to receive the bills after the bills have been evaluated, at least two of the output receptacles including a holding area and a storage area;
  - a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle into the holding areas;

an evaluating unit adapted to determine information concerning the bills, the evaluation unit including at least one evaluating sensor positioned along the transport path between the input receptacle and the plurality of output receptacles;

a plurality of bill passage sensors sequentially disposed along the transport path, each of the plurality of sensors being adapted to detect the passage of a bill as each bill is transported past each sensor;

an encoder adapted to produce an encoder count for each incremental movement of the transport mechanism; and

a controller being adapted to track the movement of bills along the transport path, the controller adapted to separately maintain a count of the number of bills transported to each of the holding areas and each of the storage areas, the controller being adapted to detect the presence of a bill jam and suspend operation of the transport mechanism when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts.

18. The currency handling device of claim 17 wherein the controller is adapted to cause the bills in each of the holding areas to be moved to the corresponding storage area after detection of a bill jam.

19. The currency handling device of claim 18 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller adapted to prompt the user for input before causing the bills in each of the holding areas to be moved to the corresponding storage areas after a bill jam is detected, the controller adapted move the bills in the holding areas to the corresponding storage areas in response to user input.

20. The currency handling device of claim 18 wherein the controller is adapted to update the count of the number of bills transported into a storage area by adding thereto the count of the number of bills transported into the corresponding holding area prior to causing the bills in the holding area to be moved to the corresponding storage area.

21. The currency handling device of claim 20 wherein the controller is adapted to reset the count of the number of bills transported into the holding area after causing the bills in each of the holding areas to be moved to the corresponding storage area.

22. The currency handling device of claim 18 wherein the controller is adapted to cause the transport mechanism to flush the bills from the transport path after causing the bills in each of the holding areas to be moved to the corresponding storage area after detection of a bill jam.

23. The currency handling device of claim 22 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller being adapted to prompt the user as whether to flush the bills, the controller being adapted to cause the transport mechanism to flush the bills in response to user input.

24. (Amended) The currency handling device of claim 17 wherein the controller is adapted to detect the presence of a bill jam in the holding areas, the controller adapted to suspend operation of the transport mechanism upon the detection of a bill jam in one of the holding areas, the controller being adapted to cause the bills in each of the holding areas not having a bill jam detected therein to be moved to the corresponding storage areas upon detection of a bill jam.

25. The currency handling device of claim 24 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller adapted to prompt the user for input before causing the bills in each of the holding areas not having a bill jam detected therein to be moved to the corresponding storage areas, the controller adapted move the bills in each of the holding areas not having bill jams detected therein to the corresponding storage areas in response to user input.

26. The currency handling device of claim 24 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller being adapted to prompt the user as whether to flush the bills, the controller being adapted to cause the transport mechanism to flush the bills from the transport path in response to user input.

27. (Amended) The currency handling device of claim 17 wherein the controller is adapted to electronically jog the transport mechanism to facilitate clearing of the bill jam in response to user input via a user interface.

28. (Amended) The currency handling device of claim 17 wherein the device is adapted to process bills at a rate of at least about 800 bills per minute.
29. (Amended) The currency handling device of claim 17 wherein the device is adapted to process bills at a rate of at least about 1500 bills per minute.
30. (Amended) The currency handling device of claim 17 further comprising:  
a bill facing mechanism disposed along the transport path between the evaluation region and the plurality of output receptacles, the bill facing mechanism being adapted to rotate a bill approximately 180°;  
a plurality of bill passage sensors sequentially disposed along the bill facing mechanism; and  
wherein the controller is adapted to detect a bill jam within the bill facing mechanism.
31. (Amended) The currency handling device of claim 17 wherein each of the output receptacles including a holding area and a storage area further include a paddle adapted to move the bills from the holding area to the corresponding storage area.
32. A method for processing currency bills with a currency handling device, the method comprising:  
receiving a plurality of bills in an input receptacle;  
transporting the bills with a transport mechanism, one at a time, from the input receptacle along a transport path into a plurality of output receptacles, at least one of the plurality of the output receptacles including a holding area and a storage area;  
determining information concerning the bills with an evaluating unit;  
maintaining a count of the total number of bills transported into each of the holding areas;  
moving the bills transported into each of the holding areas into a corresponding storage area after a predetermined number of bills have been stacked in the holding area;  
maintaining a count of the total number of bills moved into each of the storage areas;  
tracking the movement of each of the bills along the transport path; and  
detecting the presence of a bill jam when a bill is not transported past a predetermined position along the transport path within a predetermined amount of time.

33. The method of claim 32 further comprising suspending operation of the transport mechanism upon detection of a bill jam.

34. The method of claim 33 further comprising moving the bills already transported into each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.

35. The method of claim 34 further comprising updating the count for each of the storage areas of the number of bills moved into each of the storage areas by adding thereto the count of the number of bills transported into the corresponding holding areas prior to moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.

36. The method of claim 35 further comprising resetting the count of the total number of bills transported into each of the holding areas.

37. The method of claim 34 further comprising receiving input from a user of the currency handling device via a user interface, the input including operational instructions, and wherein moving the bills already transported into each of the holding areas to the corresponding storage areas further comprises moving the bills already transported into each of the holding areas to the corresponding storage areas after suspension of the operation of the transport mechanism in response to user input.

38. The method of claim 34 further comprising flushing the bills from the transport path after moving the bills already transported into each of the holding areas to the corresponding storage areas.

39. The method of claim 38 further comprising receiving input from a user of the currency handling device via a user interface, the input including operational instructions, and wherein flushing the bills further comprises flushing the bills in response to user input.

40. The method of claim 34 further comprising detecting the presence of a bill jam in one of the holding areas when a bill is not transported past a predetermined position within the holding area within a predetermined amount of time, and wherein moving the bills already



transported into each of the holding areas further comprises moving the bills already transported into each of the holding areas not having a bill jam detected therein to the corresponding storage areas upon suspension of the operation of the transport mechanism.

41. The method of claim 40 further comprising receiving input from a user of the device via a user interface, the input including operational instructions, and wherein moving the bills already transported into each of the holding areas not having a bill jam detected therein further comprises moving the bills already transported into each of the holding areas not having a bill jam detected therein to the corresponding storage areas upon suspension of the operation of the transport mechanism in response to user input.

42. The method of claim 41 further comprises flushing the bills from the transport path after moving the bills already transported into the holding areas upon suspension of the operation of the transport mechanism in response to user input.

43. The method of claim 41 wherein determining information further comprises determining information concerning the bills with an evaluating unit at a rate of at least about 800 bills per minute.

44. The method of claim 41 wherein determining information further comprises determining information concerning the bills with an evaluating unit at a rate of at least about 1500 bills per minute.

45. The method of claim 41 further comprising:  
reversing the face orientation of a bill where the face orientation of a bill does not match a target orientation with a bill facing mechanism;  
sequentially disposing a plurality of bill passage sensors along the bill facing mechanism; and  
detecting the presence of a bill jam in the bill facing mechanism when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts.

46. The method of claim 41 wherein transporting the bills further comprises stacking the bills in each of the holding areas.

47. The method of claim 41 wherein tracking the movement of each of the bills further comprises tracking the movement of each of the bills along the transport path with a plurality of bill passage sensors, each of the plurality of sensors being adapted to detect the passage of a bill as each bill is transported past each sensor.

48. The method of claim 47 further comprising generating an encoder count for each incremental movement of the transport mechanism.

49. The method of claim 48 further comprising detecting the presence of a bill jam when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts.

50. A method of handling bill jams within a currency processing device, the device including a transport mechanism adapted to transport bills along a transport path, one at a time, from the input receptacle past an evaluation unit into a plurality of output receptacles, at least two of the plurality of the output receptacles including a holding area and a storage area, the device having a plurality of bill passage sensors sequentially disposed along the transport path, each of the plurality of sensors being adapted to detect the passage of a bill as each bill is transported past each sensor, the method comprising:

- maintaining a separate count for each of the holding areas of the number of bills transported into each of the holding areas;

- moving the bills from a holding area to a corresponding storage area after a predetermined number of bills have been transported into the holding area;

- maintaining a separate count for each of the storage areas of the number of bills moved into each of the storage areas;

- tracking the movement of each of the bills along the transport path into each of the holding areas with the plurality of bill passage sensors;

- generating an encoder count for each incremental movement of the transport mechanism;

- detecting the presence of a bill jam when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts;

- suspending operation of the transport mechanism upon detection of a bill jam;

- moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism;

updating the count for each of the storage areas of the number of bills moved into each of the storage areas by adding thereto the count of the number of bills transported into the corresponding holding areas prior to moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism; and resetting the count of the total number of bills transported into each of the holding areas.

51. The method of claim 50 further comprising electronically jogging the transport mechanism.

52. The method of claim 51 further comprising flushing the bills from the transport path after moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.

53. The method of claim 51 further comprising manually clearing the bill jam from the transport path.

54. The method of claim 53 further comprising flushing the bills from the transport path after moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.

55. The method of claim 50 further comprising manually clearing the bill jam from the transport path.

56. The method of claim 55 further comprising flushing the bills from the transport path after moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.

57. The method of claim 50 further comprising receiving input from a user of the device via a user interface, the input including operational instructions, and wherein moving the bills already transported into each of the holding areas to the corresponding storage areas further comprises moving the bills already transported into each of the holding areas to the corresponding storage areas after suspension of the operation of the transport mechanism in response to user input.

58. The method of claim 57 wherein flushing the bills further comprises flushing the bills from the transport path after moving the bills already transported into the holding areas upon suspension of the operation of the transport mechanism in response to user input.

59. The method of claim 50 further comprising detecting the presence of a bill jam in one of the holding areas when a bill is not transported past one of the plurality of bill passage sensors disposed adjacent the holding area within a requisite number of encoder counts, and wherein moving the bills already transported into each of the holding areas further comprises moving the bills already transported into each of the holding areas not having a bill jam detected therein to the corresponding storage areas upon suspension of the operation of the transport mechanism.

60. The method of claim 59 further comprising receiving input from a user of the device via a user interface, the input including operational instructions, and wherein moving the bills already transported into each of the holding areas not having a bill jam detected therein further comprises moving the bills already transported into each of the holding areas not having a bill jam detected therein to the corresponding storage areas upon suspension of the operation of the transport mechanism in response to user input.

61. The method of claim 60 wherein flushing the bills further comprises flushing the bills from the transport path after moving the bills already transported into the holding areas upon suspension of the operation of the transport mechanism in response to user input.

62. The method of claim 50 wherein determining information further comprises determining information concerning the bills with an evaluating unit at a rate of at least about 800 bills per minute.

63. The method of claim 50 wherein determining information further comprises determining information concerning the bills with an evaluating unit at a rate of at least about 1500 bills per minute.

64. (Amended) The method of claim 50 further comprising:  
reversing the face orientation of a bill where the face orientation of a bill does not match a target orientation with a bill facing mechanism;

sequentially disposing a plurality of bill passage sensors along the bill facing mechanism; and

detecting the presence of a bill jam in the bill facing mechanism when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts.

Jenkins &amp; Gilchrist, P.C.

PATENT

Customer No. 23,932

Atty. Docket No. 47171-00246USP1

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**APPLICATION FOR UNITED STATES LETTERS PATENT****FOR****CURRENCY HANDLING SYSTEM HAVING  
MULTIPLE OUTPUT RECEPTACLES****BY****Charles P. Jenrick;****Robert J. Klein; and****Curtis W. Hallowell.**

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I hereby certify that this paper or fee is being deposited with the United States Postal Service "EXPRESS MAIL POST OFFICE TO ADDRESSEE" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to: Assistant Commissioner for Patents, Washington D.C. 20231.	
<u>Margaret Millas Hammond</u> Name	

## **CURRENCY HANDLING SYSTEM HAVING MULTIPLE OUTPUT RECEPTACLES**

### **CROSS-REFERENCE TO RELATED APPLICATIONS**

5           The application is a continuation-in-part of U.S. Patent Application Serial Number 09/502,666 entitled "Currency Handling System Having Multiple Output Receptacles," which was filed on February 11, 2000 and is assigned to the assignee of the present application.

### **FIELD OF THE INVENTION**

10           The present invention relates generally to the field of currency handling systems and, more particularly, to a multi-pocket currency handling system for discriminating, authenticating, and/or counting currency bills.

### **BACKGROUND OF THE INVENTION**

15           A variety of techniques and apparatuses have been used to satisfy the requirements of automated currency handling machines. As businesses and banks grow, these businesses are experiencing a greater volume of paper currency. These businesses are continually requiring not only that their currency be processed more quickly but, also, processed with  
20           more options in a less expensive manner. At the upper end of sophistication in this area of technology are machines that are capable of rapidly identifying, discriminating, and counting multiple currency denominations and then delivering the sorted currency bills into a multitude of output compartments. Many of these high end machines are extremely large and expensive such that they are commonly found only in large institutions. These  
25           machines are not readily available to businesses which have monetary and space budgets, but still have the need to process large volumes of currency. Other high end currency handling machines require their own climate controlled environment which may place even greater strains on businesses having monetary and space budgets.

30           Currency handling machines typically employ magnetic sensing or optical sensing for denominating and authenticating currency bills. The results of these processes determines to which output compartment a particular bill is delivered to in a currency handling device having multiple output receptacles. For example, ten dollar denominations may be delivered to one output compartment and twenty dollar denominations to another,

while bills which fail the authentication test are delivered to a third output compartment. Unfortunately, many prior art devices only have one output compartment which can be appropriately called a reject pocket. Accordingly, in those cases, the reject pocket may have to accommodate those bills which fail a denomination test or authentication test. As a result, different types of "reject" bills are stacked upon one another in the same output compartment leaving the operator unknowing as to which of those bills failed which tests.

Many prior art large volume currency handling devices which positively transport the currency bills through the device are susceptible to becoming jammed. And many of these machines are difficult to un-jam because the operator must physically remove the jammed bill or bills from the device. If necessary, the operator can sometimes manipulate a hand-crank to manually jog the device to remove the bills. Then, the operator must manually turn the hand crank to flush out all the bills from within the system before the batch can be reprocessed. Further compounding the problem in a bill jam situation is that many prior art devices are not equipped to detect the presence of a bill jam. In such a situation, the device continues to operate until the bills pile up and the bill jam is so severe that the device is physically forced to halt. This situation can cause physical damage to both the machine and the bills.

Often, a bill jam ruins the integrity of the count and/or valuation of the currency bills requiring that the entire batch, including those bill already processed into holding and/or storage areas, be reprocessed. Bills need to be reprocessed because prior art devices do not maintain several running totals of bills as bills pass various points within the device. Removing bills from the holding areas and/or storage areas is a time consuming process. For example, a prior device may only count the bills as they are transported through an evaluation region of the currency handling machine. Bills exiting the evaluation region are included in the totals regardless of whether they are involved in bill jams or are successfully transported to an output receptacle. Therefore, when a bill jam occurs those bills involved in the bill jam as well as those bills already transported to the storage areas and/or storage areas have to be reprocessed.

### SUMMARY OF THE INVENTION

A method and apparatus for handling bill jams within a currency processing device is provided. The device includes a transport mechanism adapted to transport bills along a transport path, one at a time, from the input receptacle past an evaluation unit



into a plurality of output receptacles. At least one of the output receptacles includes a holding area and a storage area. A plurality of bill passage sensors are sequentially disposed along the transport path that are adapted to detect the passage of a bill as each bill is transported past each sensor. An encoder is adapted to produce an encoder count for each incremental movement of the transport mechanism. A controller counts the total number of bills transported into each of the holding areas and the total number of bills moved from a holding area to a corresponding storage area after a predetermined number of bills have been transported into the holding area. The controller tracks the movement of each of the bills along the transport path into each of the holding areas with the plurality of bill passage sensors. The presence of a bill jam is detected when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts. The operation of the transport mechanism is suspended upon detection of a bill jam. The bills from each of the holding areas are moved to the corresponding storage areas upon suspension of the operation of the transport mechanism. Remaining bills are then flushed from the transport path after moving the bills from each of the holding areas to the corresponding holding areas upon suspension of the operation of the transport mechanism.

The above summary of the present invention is not intended to represent each embodiment, or every aspect, of the present invention. Additional features and benefits of the present invention will become apparent from the detail description, figures, and claim set forth below.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Other objects and advantages of the invention will become apparent upon reading the following detailed description in conjunction with the drawings in which:

FIG. 1a is a perspective view of a document handling device according to one embodiment of the invention;

FIG. 1b is a front view of a document handling device according to one embodiment of the invention;

FIG. 2a is a perspective view of an evaluation region according to one embodiment of the document handling device of the present invention;

FIG. 2b is a side view of an evaluation region according to one embodiment of the document handling device of the present invention;

FIG. 3a is a perspective view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 3b is another perspective view of an input receptacle according to one embodiment of the document handling device of the present invention;

5        FIG. 3c is a top view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 3d is a side view of an input receptacle according to one embodiment of the document handling device of the present invention;

10        FIG. 4 is a perspective view of a portion of a transportation mechanism according to one embodiment of the present invention;

FIG. 5 is a front perspective view of an escrow compartment, a plunger assembly, and a storage cassette according to one embodiment of the document handling device of the present invention;

15        FIG. 6 is a top view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

FIG. 7 is a front view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

20        FIG. 8 is another front view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

25        FIG. 9 is a perspective view of an apparatus for transferring currency from an escrow compartment to a storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 10 is a perspective view of a paddle according to one embodiment of the document handling device of the present invention;

30        FIG. 11 is a rear perspective view of the escrow compartment, plunger assembly, and storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 12 is a rear view of a plunger assembly wherein the gate is in the open position according to one embodiment of the document handling device of the present invention;

FIG. 13 is a rear view of a plunger assembly wherein the gate is in the closed position according to one embodiment of the document handling device of the present invention;

5 FIG. 14 is a perspective view of a storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 15 is a rear view of a storage cassette according to one embodiment of the document handling device of the present invention;

10 FIG. 16 is a perspective view of a storage cassette where the door is open according to one embodiment of the document handling device of the present invention;

FIG. 17a is a top view of a storage cassette sized to accommodate United States currency documents according to one embodiment of the document handling device of the present invention;

15 FIG. 17b is a rear view of a storage cassette sized to accommodate United States currency documents according to one embodiment of the document handling device of the present invention;

FIG. 18a is a top view of a storage cassette sized to accommodate large documents according to one embodiment of the document handling device of the present invention;

20 FIG. 18b is a rear view of a storage cassette sized to accommodate large documents according to one embodiment of the document handling device of the present invention; and

FIG. 19 is a functional block diagram according to one embodiment of the document handling device of the present invention.

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#### **DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS**

Referring to FIGS. 1a and 1b, a multi-pocket document processing device 100 such as a currency handling device according to one embodiment of the present invention is illustrated. Currency bills are fed, one by one, from a stack of currency bills placed in an input receptacle 102 into a transport mechanism 104. The transport mechanism 104 guides currency bills to one of a plurality of output receptacles 106a-106h, which may include upper output receptacles 106a, 106b, as well as lower output receptacles 106c-106h. Before reaching an output receptacle 106 the transport

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mechanism 104 guides the bill through an evaluation region 108 where a bill can be, for example, analyzed, authenticated, denominated, counted, and/or otherwise processed. In alternative embodiments of the currency handling device 100 of the present invention, the evaluation region 108 can determine bill orientation, bill size, or whether bills are stacked upon one another. The results of the above process or processes may be used to determine to which output receptacle 106 a bill is directed. The illustrated embodiment of the currency handling device has an overall width,  $W_1$ , of approximately 4.52 feet (1.38 meters), a height,  $H_1$ , of approximately 4.75 feet (1.45 meters), and a depth,  $D_1$ , of approximately 1.67 feet (0.50 meters).

In one embodiment, documents such as currency bills are transported, scanned, denominated, authenticated and/or otherwise processed at a rate equal to or greater than 600 bills per minute. In another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated, and/or otherwise processed at a rate equal to or greater than 800 bills per minute. In another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated and/or otherwise processed at a rate equal to or greater than 1000 bills per minute. In still another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated, and/or otherwise processed at a rate equal to or greater than 1200 bills per minute. In still another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated, and/or otherwise processed at a rate equal to or greater than 1500 bills per minute.

In the illustrated embodiment, interposed in the bill transport mechanism 104, intermediate the bill evaluation region 108 and the lower output receptacles 106c-106h is a bill facing mechanism designated generally by reference numeral 110. The bill facing mechanism is capable of rotating a bill 180° so that the face position of the bill is reversed. That is, if a U.S. bill, for example, is initially presented with the surface bearing a portrait of a president facing down, it may be directed to the facing mechanism 110, whereupon it will be rotated 180° so that the surface with the portrait faces up. The leading edge of the bill remains constant while the bill is being rotated 180° by the facing mechanism 110. The decision may be taken to send a bill to the facing mechanism 110 when the selected mode of operation or other operator instructions call for maintaining a given face position of bills as they are processed by the currency handling device 100. For example, it may be desirable in certain

circumstances for all of the bills ultimately delivered to the lower output receptacles 106c-106h to have the bill surface bearing the portrait of the president facing up. In such embodiments of the currency handling device 100, the bill evaluation region 108 is capable of determining the face position of a bill, such that a bill not having the  
5 desired face position can first be directed to the facing mechanism 110 before being delivered to the appropriate output receptacle 106. Further details of a facing mechanism which may be utilized for this purpose are disclosed in commonly-owned, U.S. Patent No. 6,047,334, incorporated herein by reference in its entirety, which may be employed in conjunction with the present invention such as the device illustrated in  
10 FIGS. 1a and 1b. Alternatively, the facing mechanism disclosed in commonly-owned co-pending U.S. Application Serial No. 09/503,039, entitled "Two Belt Bill Facing Mechanism" which was filed on February 11, 2000, incorporated herein by reference in its entirety, may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b. Other alternative embodiments of the currency  
15 handling device 100 do not include the facing mechanism 110.

The currency handling device 100 in FIG. 1a may be controlled from a separate controller or control unit 120 which has a display/user-interface 122, which may incorporate a touch panel display in one embodiment of the present invention, which displays information, including "functional" keys when appropriate. The display/user-  
20 interface 122 may be a full graphics display. Alternatively, additional physical keys or buttons, such as a keyboard 124, may be employed. The control unit 120 may be a self-contained desktop or laptop computer which communicates with the currency handling device 100 via a cable 125. The currency handling device 100 may have a suitable communications port (not shown) for this purpose. In embodiments in which  
25 the control unit 120 is a desktop computer wherein the display/user-interface 122 and the desktop computer are physically separable, the desktop computer may be stored within a compartment 126 of the currency handling device 100. In other alternative embodiments, the control unit 120 is integrated into the currency handling device 100 so the control unit 120 is contained within the device 100.

30 The operator can control the operation of the currency handling device 100 through the control unit 120. Through the control unit 120 the operator can direct the bills into specific output receptacles 106a-106h by selecting various user defined modes. In alternative embodiments, the user can select pre-programmed user defined

modes or create new user defined modes based on the particular requirements of the application. For example, the operator may select a user defined mode which instructs the currency handling device 100 to sort bills by denomination; accordingly, the evaluation region 108 would denominate the bills and direct one dollar bills into the first lower output receptacle 106c, five dollar bills into the second lower output receptacle 106d, ten dollar bills into the third lower output receptacle 106e, twenty dollar bills into the fourth lower output receptacle 106f, fifty dollar bills into the fifth lower output receptacle 106g, and one-hundred dollar bills into the sixth lower output receptacle 106h. The operator may also instruct the currency handling device 100 to deliver those bills whose denomination was not determined, no call bills, to the first upper output receptacle 106a. In such an embodiment, upper output receptacle 106a would function as a reject pocket. In an alternative embodiment, the operator may instruct the currency handling device 100 to also evaluate the authenticity of each bill. In such an embodiment, authentic bills would be directed to the appropriate lower output receptacle 106c-106h. Those bills that were determined not to be authentic, suspect bills, would be delivered to the second upper output receptacle 106b. A multitude of user defined modes are disclosed by co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Multi-Pocket Currency Discriminator" which was filed on August 21, 1997, incorporated herein by reference in its entirety, which may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b.

According to one embodiment, the currency handling device 100 is designed so that when the evaluation region 108 is unable to identify certain criteria regarding a bill, the unidentified note is flagged and "presented" in one of the output receptacles 106a-106h, that is, the transport mechanism 104 is stopped so that the unidentified bill is located at a predetermined position within one of the output receptacles 106a-106h, such as being the last bill transported to one of the output receptacles. Such criteria can include denominating information, authenticating information, information indicative of the bill's series, or other information the evaluation region 108 is attempting to obtain pursuant to a mode of operation. Which output receptacles 106a-106h the flagged bill is presented in may be determined by the user according to a selected mode of operation. For example, where the unidentified bill is the last bill transported to an output receptacle 106a-106h, it may be positioned within a stacker

wheel or positioned at the top of the bills already within the output receptacle 106a-106h. While unidentified bills may be transported to any output receptacles 106a-106h, it may be more convenient for the operator to have unidentified bills transported to one of the upper output receptacles 106a,b where the operator is able to easily see  
5 and/or inspect the bill which has not been identified by the evaluation region 108. The operator may then either visually inspect the flagged bill while it is resting on the top of the stack, or alternatively, the operator may decide to remove the bill from the output receptacle 106 in order to examine the flagged bill more closely. In an alternative embodiment of the currency handling device 100, the device 100 may communicate to  
10 the user via the display/user-interface 122 in which one of the output receptacles 106a-106h a flagged bill is presented.

The currency handling device 100 may be designed to continue operation automatically when a flagged bill is removed from the upper output receptacle 106a,b or, according to one embodiment of the present invention, the device 100 may be  
15 designed to suspend operation and require input from the user via the control unit 120. Upon examination of a flagged bill by the operator, it may be found that the flagged bill is genuine even though it was not identified as so by the evaluation region 108 or the evaluation may have been unable to denominate the flagged bill. However, because the bill was not identified, the total value and/or denomination counters will not reflect  
20 its value. According to one embodiment, such an unidentified bill is removed from the output receptacles 106 and reprocessed or set aside. According to another embodiment, the flagged bills may accumulate in the upper output receptacles 106a,b until the batch of currency bills currently being processed is completed or the output receptacle 106a,b is full and then reprocessed or set aside.

25 According to another embodiment, when a bill is flagged, the transport mechanism may be stopped before the flagged bill is transported to one of the output receptacles. Such an embodiment is particularly suited for situations in which the operator need not examine the bill being flagged; for example, the currency handling device 100 is instructed to first process United States currency and then British  
30 currency pursuant to a selected mode of operation where the currency handling device 100 processes United States \$1, \$5, \$10, \$20, \$50, and \$100 currency bills into the lower output receptacles 106c-106h, respectively. Upon detection of the first British pound note, the currency handling device 100 may halt operation allowing the operator

to empty the lower output receptacles 106c-106h and to make any spatial adjustments necessary to accommodate the British currency. A multitude of modes of operation are described in conjunction with bill flagging, presenting, and/or transport halting in commonly owned, co-pending U.S. Patent Application Serial No. 08/916,100 entitled  
5 "Method and Apparatus for Document Processing" which was filed on May 28, 1997, incorporated herein by reference in its entirety above, which may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b.

In the illustrated embodiment, with regard to the upper output receptacles  
10 106a, 106b, the second upper output receptacle 106b is provided with a stacker wheel 127 for accumulating a number of bills, while the first upper output receptacle 106a is not provided with such a stacker wheel. Thus, when pursuant to a preprogrammed mode of operation or an operator selected mode or other operator instructions, a bill is to be fed to the first upper output receptacle 106a, there may be a further instruction to  
15 momentarily suspend operation of the currency handling device 100 for the operator to inspect and remove the bill. On the other hand, it may be possible to allow a small number of bills to accumulate in the first upper output receptacle 106a prior to suspending operation. Similarly, the second upper output receptacle 106b may be utilized initially as an additional one of the lower output receptacles 106c-106h.  
20 However, there is no storage cassette associated with the second upper output receptacle 106b. Therefore, when the second upper output receptacle 106b is full, operation may be suspended to remove the bills at such time as yet further bills are directed to the second upper output receptacle 106b in accordance with the selected mode of operation or other operator instructions. In an alternative embodiment of the  
25 currency handling device 100 both the first and the second upper output receptacles 106a-b are equipped with a stacker wheel. In such an embodiment both the upper output receptacles 106a-b may also function as the lower output receptacle 106c-106h allowing a number of bills to be stacked therein; however, in the illustrated embodiment, there are no storage cassettes associated with the upper output  
30 receptacles 106a-b.

FIGS. 2a and 2b illustrate the evaluation region 108 according to one embodiment of the currency handling system 100. The evaluation region can be opened for service, access to sensors, clear bill jams, *etc.* as shown in FIG. 2a. The



characteristics of the evaluation region 108 may vary according to the particular application and needs of the user. The evaluation region 108 can accommodate a number and variety of different types of sensors depending on a number of variables. These variables are related to whether the machine is authenticating, counting, or discriminating denominations and what distinguishing characteristics are being examined, *e.g.* size, thickness, color, magnetism, reflectivity, absorbability, transmissivity, electrical conductivity, etc. The evaluation region 108 may employ a variety of detection means including, but not limited to, a size detection and density sensor 408, a lower 410 and an upper 412 optical scan head, a single or multitude of magnetic sensors 414, a thread sensor 416, and an ultraviolet/fluorescent light scan head 418. These detection means and a host of others are disclosed in commonly owned, co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Multi-Pocket Currency Discriminator," incorporated by reference above.

The direction of bill travel through the evaluation region 108 is indicated by arrow A. The bills are positively driven along a transport plate 400 through the evaluation region 108 by means of a transport roll arrangement comprising both driven rollers 402 and passive rollers 404. The rollers 402 are driven by a motor (not shown) via a belt 401. Passive rollers 404 are mounted in such a manner as to be freewheeling about their respective axis and biased into counter-rotating contact with the corresponding driven rollers 402. The driven and passive rollers 402, 404 are mounted so that they are substantially coplanar with the transport plate 400. The transport roll arrangement also includes compressible rollers 406 to aid in maintaining the bills flat against the transport plate 400. Maintaining the bill flat against the transport plate 400 so that the bill lies flat when transported past the sensors enhances the overall reliability of the evaluation processes. A similar transport arrangement is disclosed in commonly-owned United States Patent No. 5,687,963 entitled "Method and Apparatus for Discriminating and Counting Documents," which is incorporated herein by reference in its entirety.

Referring now to FIGS. 3a-3d, the input receptacle 102 of the currency handling device 100 is illustrated. A feeder mechanism such as a pair of stripping wheels 140 aid in feeding the bills in seriatim to the transport mechanism 104 which first carries the bills through the evaluation region 108. According to one embodiment, the input receptacle 102 includes at least one spring-loaded feeder paddle 142a which

is pivotally mounted, permitting it to be pivoted upward and drawn back to the rear of a stack of bills placed in the input receptacle 102 so as to bias the bills towards the evaluation region 108 via the pair of stripping wheels 140. The paddle 142a is coupled to an advance mechanism 144 to urge the paddle 142a towards the stripping wheels 140. In the illustrated embodiment, motion is imparted to the advance mechanism via a spring 145. In other alternative embodiments, the advance mechanism 144 is motor driven. The advance mechanism 144 is slidably mounted to a shaft 146. The advance mechanism 144 also constrains the paddle 142a to a linear path. The advance mechanism 144 may contain a liner bearing (not shown) allowing the paddle 142a to easily slide along the shaft 146. In the embodiment illustrated, the paddle 142a may also contain channels 148 to aid in constraining the paddle 142a to a linear path along a pair of tracks 150. The paddle 142a may additionally include a roller 152 to facilitate the movement of the paddle 142a.

In the embodiment illustrated in FIGS. 3a-3d, a second paddle 142b is provided such that a second stack of bills 147 may be placed in the input receptacle 102 behind a first group of bills 149, while the first group of bills 149 is being fed into the currency handling device 100. Thus, the two feeder paddles 142a and 142b may be alternated during processing in order to permit multiple stacks of currency bills to be loaded into the input receptacle 102. In such an embodiment, the operator would retract paddle 142a and place a stack of bills into the input receptacle. Once inside the input receptacle, the operator would place the paddle 142a against the stack of bills so that the paddle 142a biases the stack of bills towards the pair of stripper wheels 140. The operator could then load a second stack of bills into the input receptacle 102 by retracting the second paddle 142b and placing a stack of bills in the input receptacle between the paddles 142a and 142b. The second paddle 142b urges the second stack of bills up against the backside of the first paddle 142a. The operator can then upwardly rotate the first paddle 142a thus combining the two stacks. The first paddle 142a is then retracted to the rear of the input receptacle and the process can be repeated. The two paddle input receptacle allows the operator to more easily continuously feed stacks of bills to the currency handling device 100. In devices not having two feeder paddles, the operator is forced to awkwardly manipulate the two stacks of bills and the advance mechanism. Alternatively, the operator may wait for the stack of bills to be processed out of the input receptacle to add another stack;

however, waiting to reload until each stack is processed adds to the total time to process a given amount of currency.

Referring to FIG. 4, a portion of the transport mechanism 104 and diverters 130a-130d are illustrated. A substantial portion of the transport path of the currency handling device 100 positively grips the bills during transport from the pair of stripping wheels 140 through the point where bills are delivered to upper output receptacle 106a or are delivered to the stacker wheels 202 of output receptacles 106b-106h. The positive grip transport path of the currency handling device 100 is less costly and weighs less than the vacuum transport arrangements of prior currency processing devices.

The transport mechanism 104 is electronically geared causing all sections to move synchronously from the evaluation region 108 through the point where the bills are delivered to the output receptacles 106. Multiple small motors are used to drive the transport mechanism 104. Using multiple small, less costly motors is more efficient and less costly than a single large motor. Further, less space is consumed enabling the currency handling device 100 to be more compact. Electronically gearing the transport mechanism 104 enables a single encoder to monitor bill transportation within the currency handling system 100. The encoder is linked to the bill transport mechanism 104 and provides input to a processor to determine the timing of the operations of the currency handling device 100. In this manner, the processor is able to monitor the precise location of the bills as they are transported through the currency handling device 100. This process is termed "flow control." Input from additional sensors 119 located along the transport mechanism 104 of the currency handling device 100 enables the processor to continually update the position of a bill within the device 100 to accommodate for bill slippage. When a bill leaves the evaluation region 108 the processor expects the bill to arrive at the diverter 130a corresponding to the first lower output receptacle 106c after a precise number of encoder counts. Specifically, the processor expects the bill to flow past each sensor 119 positioned along the transport mechanism 104 at a precise number of encoder counts. If the bill slips during transport but passes a sensor 119 later within an acceptable number of encoder counts the processor updates or "re-queues" the new bill position. The processor calculates a new figure for the time the bill is expected to pass the next sensor 119 and arrive at the first diverter 130a. The processor activates the one of the diverters 130a-f to direct

the bill into the appropriate corresponding lower output receptacle 106c-106h when the sensor 119 immediately preceding the diverter 130 detects the passage of the bill to be directed into the appropriate lower output receptacle 106c-h.

5 The currency handling device 100 also uses flow control to detect bill jams within the transport mechanism 104 of the device 100. When a bill does not reach a sensor 119 within in the calculated number of encoder counts plus the maximum number of counts allowable for slippage, the processor suspends operation of the device 100 and informs the operator via the display/user-interface 122 that a bill jam has occurred. The processor also notifies the operator via the display/user-interface 10 122 of the location of the bill jam by indicating the last sensor 119 that the bill passed and generally the approximate location of the bill jam in the system. If the operator cannot easily remove the bill without damage, the operator can then electronically jog the transport path in the forward or reverse direction via the control unit 120 so that the jammed bill is dislodged and the operator can easily remove the bill from the transport path. The operator can then flush the system causing the transport 15 mechanism 104 to deliver all of the bills currently within the transport path of the currency handling device 100 to one of the output receptacles 106. In an alternative embodiment, the user of the currency handling device 100 would have the option when flushing the system to first have the bills already within the escrow regions 116a-116f to be delivered to the respective lower storage cassettes 106c-106h so that those bills 20 may be included in the aggregate value data for the bills being processed. The bills remaining in the transport path 104 would then be delivered to a predetermined escrow region 116 where those bills could be removed and reprocessed by placing those bills in the input receptacle 102.

25 Utilizing flow control to detect bill jams is more desirable than prior art currency evaluation machines which do not detect a bill jam until a sensor is actually physically blocked. The latter method of bill jam detection permits bills to pile up while waiting for a sensor to become blocked. Bill pile-up is problematic because it may physically halt the machine before the bill jam is detected and may cause physical damage to the bills and the machine. In order to remedy a bill jam in a prior art 30 machine, the operator must first manually physically dislodge the jammed bills. The operator must then manually turn a hand crank which advances the transport path until all bills within the transport path are removed. Moreover, because the prior art devices

permit multiple bills to pile up before a bill jam is detected, the integrity of the process is often ruined. In such a case, the entire stack of bills must be reprocessed.

Referring back to FIG. 1a, the illustrated embodiment of the currency handling device 100 includes a total of six lower output receptacles 106c-106h. More specifically, each of the lower output receptacles 106c-106h includes a first portion designated as an escrow compartment 116a-116f and a second portion designated as a storage cassette 118a-118f. Typically, bills are initially directed to the escrow compartments 116, and thereafter at specified times or upon the occurrence of specified events, which may be selected or programmed by an operator, bills are then fed to the storage cassettes 118. The storage cassettes are removable and replaceable, such that stacks of bills totaling a predetermined number of bills or a predetermined monetary value may be accumulated in a given storage cassette 118, whereupon the cassette may be removed and replaced with an empty storage cassette. In the illustrated embodiment, the number of lower output receptacles 106c-106h including escrow compartments 116 and storage cassettes 118 are six in number. In alternative embodiments, the currency handling device 100 may contain more or less than six lower output receptacles including escrow compartments and storage cassettes 118. In other alternative embodiments, modular lower output receptacles 106 can be implemented to add many more lower output receptacles to the currency handling system 100. Each modular unit may comprise two lower output receptacles. In other alternative embodiments, several modular units may be added at one time to the currency handling device 100.

A series of diverters 130a-130f, which are a part of the transportation mechanism 104, direct the bills to one of the lower output receptacles 106c-106h. When the diverters 130 are in an upper position, the bills are directed to the adjacent lower output receptacle 106. When the diverters 130 are in a lower position, the bills proceed in the direction of the next diverter 130.

The vertical arrangement of the lower output receptacles 106c-106h is illustrated in FIG. 5. The escrow compartment 116 is positioned above the storage cassette 118. In addition to the escrow compartment 116 and the storage cassette 118, each of the lower output receptacles 106c-106h contains a plunger assembly 300. The plunger assembly 300 is shown during its decent towards the storage cassette 118.

Referring now to FIGS. 6 and 7, one of the escrow compartments 116 of the lower output receptacles 106c-106h is shown. The escrow compartment 116 contains a stacker wheel 202 to receive the bills 204 from the diverter 130. The stacker wheel 202 stacks the bills 204 within the escrow compartment walls 206, 208 on top of a gate 210 disposed between the escrow compartment 116 and the storage cassette 118. In an alternative embodiment, the escrow compartment 116 contains a pair of guides to aid in aligning the bills substantially directly on top of one another. The gate 210 is made up of two shutters: a first shutter 211 and a second shutter 212. The shutters 211, 212 are hingedly connected enabling the shutters 211, 212 to rotate downward approximately ninety degrees to move the gate from a first position (closed position) wherein the shutters 211, 212 are substantially co-planer to a second position (open position) wherein the shutters 211, 212 are substantially parallel. Below the gate 210 is the storage cassette 118 (not shown in FIGS. 6 and 7).

FIG. 8 illustrates the positioning of the paddle 302 when transferring a stack of bills from the escrow compartment 116 to the storage cassette 118. When the paddle descends upon the stack of bills 204 it causes shutters 211, 212 to quickly rotate in the directions referred to by arrows B and C, respectively; thus, "snapping" open the gate 210. The quick rotation of the shutters 211, 212 insures that the bills fall into the storage cassette 118 in a substantially stacked position. According to one embodiment, the paddle is programmed to descend after a predetermined number of bills 204 are stacked upon the gate 210. According to other embodiments, the operator can instruct the paddle 302 via the control unit 120 to descend upon the bills 204 stacked upon the gate 210.

Referring now to FIG. 9, the plunger assembly 300 for selectively transferring the bills 204 from an escrow compartment 116 to a corresponding storage cassette 118 and the gate 210 are illustrated in more detail. One such plunger assembly 300 is provided for each of the six lower output receptacles 106c-106h of the currency handling device 100. The plunger assembly 300 comprises a paddle 302, a base 304, and two side arms 306, 308. Each of the shutters 211, 212 comprising the gate 210 extend inwardly from corresponding parallel bars 214, 215. The bars 214, 215 are mounted for pivoting the shutters between the closed position and the open position. Levers 216, 217 are coupled to the parallel bars 214, 215, respectively, to control the rotation of the bars 214, 215 and hence of the shutters 211, 212. Extension springs

218, 219 (shown in FIG. 8) tend to maintain the position of the levers 216, 217 both in the closed and open positions. The shutters 211, 212 have an integral tongue 213a and groove 213b arrangement which prevents any bills which are stacked upon the gate 210 from slipping between the shutters 211, 212.

5           The base 304 travels along a vertical shaft 311 with which it is slidably engaged. The base 304 may include linear bearings (not shown) to facilitate its movement along the vertical shaft 311. The plunger assembly 300 may also include a vertical guiding member 312 (see FIG. 11) with which the base 304 is also slidably engaged. The vertical guiding member 312 maintains the alignment of the plunger  
10 assembly 300 by preventing the plunger assembly 300 from twisting laterally about the vertical shaft 311 when the paddle 302 forces the bills 204 stacked in the escrow area 116 down into a storage cassette 118.

          Referring also to FIG. 10, the paddle 302 extends laterally from the base 304. The paddle 302 is secured to a support 314 extending from the base 304. A pair of  
15 side arms 306, 308 are hingedly connected to the base. Each of the side arms 306, 308 protrude from the sides of the base 304. Rollers 316, 318 are attached to the side arms 306, 308, respectively, and are free rolling. Springs 313a, 313b are attached to the side arms 306, 308, respectively, to bias the side arms 306, 308 outward from the base 304. In the illustrated embodiment, the spring 313a, 313b are compression springs.

20           The paddle 302 contains a first pair of slots 324 to allow the paddle to clear the stacker wheel 202 when descending into and ascending out of the cassette 118. The first pair of slots 324 also enables the paddle 302 to clear the first pair of retaining tabs 350 within the storage cassette (see FIG. 14). Similarly, paddle 302 contains a second pair of slots 326 to enable the paddle 302 to clear the second pair of retaining tabs 350  
25 within the storage cassette 118 (see FIG. 14).

          Referring now to FIG. 11, which illustrates a rear view of one of the lower output receptacles 106c-106h, the plunger 300 is bidirectionally driven by way of a belt 328 coupled to an electric motor 330. A clamp 332 engages the belt 328 into a channel 334 in the base 304 of the plunger assembly 300. In the embodiment  
30 illustrated in FIG. 11, two plunger assemblies 300 are driven by a single electric motor 330. In one embodiment of the currency handling device, the belt 328 is a timing belt. In other alternative embodiments, each plunger assembly 300 can be driven by a single

electric motor 330. In still other alternative embodiments, there can be any combination of motors 330 to plunger assemblies 300.

FIGS. 12 and 13 illustrate the interaction between the side arms 306, 308 and the levers 216, 217 when the paddle assembly 300 is descending towards and ascending away from the storage cassette 118, respectively. Initially, before descending towards the cassette, the shutters are in a first (closed) position. In the illustrated embodiment, it is the force imparted by the paddle 302 which opens the gate 210 when the paddle descends towards the storage cassette 118. When the paddle is ascending away from the storage cassette 119, it is the rollers 316, 318 coupled to the side arms 306, 308 which engage the levers 216, 217 that close the gate 210. The levers 216, 217 shown in FIG. 12 are positioned in the open position. When descending towards the storage cassette 118, the rollers 316, 318 contact the levers 216, 217 and roll around the levers 216, 217 leaving the shutters in the open position. The side arms 306, 308 are hinged in a manner which allows the side arms 306, 308 to rotate inward towards the base 304 as the rollers 316, 318 engage the levers 216, 217. FIG. 13 illustrates the levers in the second position wherein the gate 210 is closed. When the paddle ascends out of the storage cassette, the side arms 306, 308 are biased away from the base 304. The rollers 316, 318 engage the levers 216, 217 causing the levers to rotate upward to the first position thus closing the gate.

FIGS. 14, 15, and 16 illustrate the components of the storage cassettes 118. The bills 204 are stored within the cassette housing 348 which has a base 349. Each storage cassette 118 contains two pairs of retaining tabs 350 positioned adjacent to the interior walls 351, 352 of the storage cassette. The lower surface 354 of each tab 350 is substantially planar. The tabs 350 are hingedly connected to the storage cassette 118 enabling the tabs 350 to downwardly rotate from a horizontal position, substantially perpendicular with the side interior walls 351, 352 of the cassette 118, to a vertical position, substantially parallel to the interior walls 351, 352 of the cassette 118. The tabs 350 are coupled to springs (not shown) to maintain the tabs in the horizontal position.

The storage cassette 118 contains a slidable platform 356 which is biased upward. During operation of the currency handling system 100, the platform 356 receives stacks of bills from the escrow compartment 116. The floor 356 is attached to a base 358 which is slidably mounted to a vertical support member 360. The base



358 is spring-loaded so that it is biased upward and in turn biases the platform 356 upward. The storage cassettes 118 are designed to be interchangeable so that once full, a storage cassette can be easily removed from the currency handling device 100 and replaced with an empty storage cassette 118. In the illustrated embodiment, the storage cassette 118 is equipped with a handle 357 in order to expedite removal and/or replacement of the storage cassettes 118. Also in the illustrated embodiment, the storage cassette 118 has a door 359 which enables an operator to remove bills from the storage cassette 118

The storage cassettes 118 are dimensioned to accommodate documents of varying sizes. In the illustrated embodiment, the storage cassettes 118 has a height,  $H_2$ , of approximately 15.38 inches (39 cm), a depth,  $D_2$ , of approximately 9 inches (22.9 cm), and a width,  $W_2$ , of approximately 5.66 inches (14.4 cm). The storage cassette illustrated in FIG. 15 has stand-offs 362 to set interior wall 352 off a fixed distance from in the interior wall 353 of the cassette housing 348. The interior walls 351, 352 aid in aligning the bills in a stack within the storage cassettes. The embodiment of the storage cassette illustrate in FIG. 15 is sized to accommodate United States currency documents. To properly accommodate United States currency documents, the interior width of the storage cassette,  $W_3$ , is approximately 2.88 inches. FIGS. 17a and 17b also illustrate an embodiment of the storage cassette 118 sized to accommodate U.S. currency documents which have a width of approximately 2.5 inches (approximately 6.5 cm) and a length of approximately 6 inches (approximately 15.5 cm). In alternative embodiments, the length of the stand-offs 362 can be varied to accommodate documents of varying sizes. For example, the embodiment disclosed in FIG. 18a and 18b has an interior width,  $W_3$  of approximately 4.12 inches (104.6 cm) and is sized to accommodate the largest international currency, the French 500 Franc note, which has width of approximately 3.82 inches (9.7 cm) and a length of approximately 7.17 inches (18.2 cm). In order to accommodate large documents and increase the interior width,  $W_3$ , of the storage cassette 118, the lengths of stand-offs 362, illustrated in FIG. 16b, are shortened.

Beginning with FIG. 7, the operation of one of the lower output receptacles 106c-106h will be described. Pursuant to a mode of operation, the bills 204 are directed by one of the diverters 130 into the escrow compartment 116 of the lower output receptacle. The stacker wheel 202 within escrow compartment 116 receives

the bills 204 from the diverter 130. The stacker wheel 202 stacks the bills 204 on top of the gate 210. Pursuant to a preprogrammed mode of operation, once a predetermined number of bills 204 are stacked in the escrow compartment 116, the control unit 120 instructs the currency handling device 100 to suspend processing currency bills and the paddle 302 then descends from its home position above the escrow compartment 116 to transfer the bills 204 into the storage cassette 118. Once the bills 204 have been deposited in the storage cassette 118 the currency handling device resumes operation until an escrow compartment is full or all the bills within the input receptacle 102 have been processed.

Referring now to FIGS. 8 and 9 the plunger assembly 300 downwardly travels placing the paddle 302 onto of the stack of bills 204. Upon making contact with the bills 204 the paddle 302 continues to travel downward. As the paddle 302 continues its descent, the paddle 302 forces the gate 210 to snap open. The paddle 302 imparts a force to the bills 204 that is transferred to the to the shutters 211, 212 causing the shutters 211, 212 to rotate from the closed position to the open position. The rotation of the shutters 211, 212 is indicated by the arrows B and C, respectively. Once the paddle 302 imparts the amount of force necessary to rotate levers 216, 217, the extension springs 218, 219 quickly rotate the shutters 211, 212 downward, thus "snapping" the gate 210 open. The downward rotation of the shutters 211, 212 causes each of the corresponding parallel bars 214, 215 to pivot which in turn rotates the levers 216, 217. The extension springs 218, 219 maintain the shutters 211, 212 in the open position allowing the paddle 302 to descend into the storage cassette 118. The hingedly connected side arms 306, 308 retract as the rollers 316, 318 to roll around the levers 216, 217 while the plunger assembly 300 is traveling downward into the cassette 118.

Referring now to FIG. 15, once the gate 210 is opened, the bills 204 fall a short distance onto the platform 356 of the storage cassette 118 or onto a stack of bills 204 already deposited on the platform 356. The paddle 302 continues its downward motion towards the storage cassette 118 to ensure that the bills 204 are transferred to the cassette 118. Initially, some bills 204 may be spaced apart from the platform 356 or the other bills 204 within the storage cassette by retaining tabs 350. As the plunger assembly 300 continues to descend downward into the cassette, the paddle 302 continues to urge the stack of bills 204 downward causing the retaining tabs 350 to

rotate downward. The bills 204 are pushed past retaining tabs 350 and onto the platform 356.

Once the plunger assembly 300 has descended into the cassette 118 a distance sufficient for the paddle 302 to clear the retaining tabs 350 allowing the retaining tabs 350 to rotate upward, the plunger assembly initiates its ascent out of the storage cassette 118. The platform 356 urges the bills 204 upward against the underside of the paddle 302. The paddle 302 is equipped with two pairs of slots 324, 326 (FIG. 9) to enable the paddle to clear the pairs of retaining tabs 350. When the paddle 302 ascends past the pairs of retaining tabs 350 the bills 204 are pressed against the lower surfaces 354 of the pairs of retaining tabs 350 by the platform 356.

Referring now to FIG. 13, when the plunger assembly 300 is traveling upward out of the cassette 118, the rollers 316, 318 on the side arms 306, 308 engage the respective levers 216, 217 and move the respective levers 216, 217 from the second (open) position to the first (closed) position to move the gate 210 from the open position to the closed position as the paddle 302 ascends into the escrow compartment 116 after depositing the bills 204 in the storage cassette 118. The paddle 302 is mounted on the base 304 above the rollers 316, 318 on the side arms 306, 308 so that the paddle 302 clears the gate 210 before the gate 210 is moved to the closed position.

In alternative embodiments of the currency handling device 100, the output receptacles 106 can be sized to accommodate documents of varying sizes such as various international currencies, stock certificates, postage stamps, store coupons, *etc.* Specifically, to accommodate documents of different widths, the width of the escrow compartment 116, the gate 210, and the storage cassette 118 would need to be increased or decreased as appropriate. The document evaluation device 100 is sized to accommodate storage cassettes 118 and gates 210 of different widths. The entire transport mechanism 104 of the currency handling device 100 is dimensioned to accommodate the largest currency bills internationally. Accordingly, the document handling device 100 can be used to process the currency or documents of varying sizes.

In various alternative embodiments, the currency handling device 100 is dimensioned to process a stack of different sized currencies at the same time. For example, one application may require the processing of United States dollars (2.5 inches x 6 inches, 6.5 cm x 15.5 cm) and French currency (as large as 7.17 inches x

3.82 inches, 18.2 cm x 9.7 cm). The application may simply require the segregation of the U.S. currency from the French currency wherein the currency handling device 100 delivers U.S. currency to the first lower output receptacle 106c and the French currency to the second output receptacle 106d. In another alternative embodiment, the currency handling device 100 processes a mixed stack of U.S. ten and twenty dollar bills and French one hundred and two hundred Franc notes wherein the currency documents are denominated, counted, and authenticated. In that alternative embodiment, the U.S. ten and twenty dollar bills are delivered to the first 106c and second 106d lower output receptacles, respectively, and the French one hundred and two hundred Franc notes are delivered to the third 106e and fourth 106f lower output receptacle, respectively. In other alternative embodiments, the currency handling device 100 denominates, counts, and authenticates six different types of currency wherein, for example, Canadian currency is delivered to the first lower output receptacle 106c, United States currency is delivered to the second output receptacle 106d, Japanese currency is delivered to the third lower output receptacle 106e, British currency is delivered to the fourth lower output receptacle 106f, French currency is delivered to the fifth lower output receptacle 106g, and German currency is delivered to the sixth lower output receptacle 106h. In another embodiment, no call bills or other denominations of currency, such as Mexican currency for example, may be directed to the second upper output receptacle 106b. In another embodiment, suspect bills are delivered to the first upper output receptacle 106a.

In other alternative embodiments of the currency handling device 100, the user can vary the type of documents delivered to the output receptacles 106. For example, in one alternative embodiment an operator can direct, via the control unit 120, that a stack of one, five, ten, twenty, fifty, and one-hundred United States dollar bills be denominated, counted, authenticated, and directed into lower output receptacles 106c-106h, respectively. In still another alternative embodiment, the currency handling device 100 is also instructed to deliver other bills, such as a United States two dollar bill or currency documents from other countries that have been mixed into the stack of bills, to the second upper output receptacle 106b. In still another alternative embodiment, the currency handling device 100 is also instructed to count the number and aggregate value of all the currency bills processed and the number and aggregate value of each individual denomination of currency bills processed. These values can be

communicated to the user via the display/user-interface 122 of the currency handling device 100. In still another alternative embodiment, no call bills and bills that are stacked upon one another are directed to the second upper output receptacle 106b. In still another alternative embodiment, the operator can direct that all documents failing an authentication test be delivered to the first upper output receptacle 106a. In another alternative embodiment, the operator instructs the currency handling device 100 to deliver no call bills, suspect bills, stacked bills, *etc.* to one of the lower output receptacles 106c-106h. The currency handling device 100 which has eight output receptacles 106a-106h provides a great deal of flexibility to the user. And in other alternative embodiments of the currency handling device 100, numerous different combinations for processing documents are available.

According to one embodiment, the various operations of the currency handling device 100 are controlled by processors disposed on a number of printed circuit boards ("PCBs") such as ten PCBs located throughout the device 100. In one embodiment of the present invention, the processors are Motorola processors, model number 86HC16, manufactured by Motorola, Inc. of Schaumburg, Illinois. Each of the processors are linked to a central controller via a general purpose communications controller disposed on each PCB. In one embodiment of the present invention the communications controller is an ARCNET communications controller, model COM20020, manufactured by Standard Microsystems Corporation of Hauppauge, New York. The communications controller enables the central controller to quickly and efficiently communicate with the various components linked to the PCBs.

According to one embodiment, two PCBs, a "motor board" and a "sensor board," are associated with each pair of lower output receptacles 106c-106h. The first two lower output receptacles 106c,d, the second two lower output receptacles 106e,f, and the last two lower output receptacles 106g,h are paired together. Each of the lower output receptacles 106 contain sensors which track the movement of the bills into the lower output receptacles 106c-106h, detect whether each storage cassette 118a-118e is positioned within the currency handling device 100, detect whether the doors 359 of the storage cassettes 118 are opened or closed, and whether the cassettes 118 are full. These aforementioned sensors associated with each pair of the lower output receptacles are tied into a sensor board which is linked to the central controller. The operation of the plunger assembly 300, the stacker wheels 202, the portion of

transportation mechanism 104 disposed above the lower output receptacles 116c-116h, and the diverters 130 are controlled by processors disposed on the motor board associated with each pair of lower output receptacle's 106c-106h. Those sensors 130 which track the movement of bills along the transportation mechanism 104 that are  
5 disposed directly above the lower output receptacles 106c-106h are also tied into the respective motor boards.

One of the four remaining PCBs is associated with the operation of the one or two stacker wheels 127 associated with the upper output receptacles 106a,b, the stripping wheels 140, the primary drive motor of the evaluation region 108, a diverter  
10 which direct bills to the two upper output receptacles 106a,b, and the diverter which then directs bills between the two upper output receptacles 106a,b. The remaining three PCBs are associated with the operation of the transport mechanism 104 and a diverter which directs bills from the transport path to the bill facing mechanism 110. The plurality of sensors 130 disposed along the transport mechanism 104, used to  
15 track the movement of bills along the transport mechanism 104, also tied into these three remaining PCBs.

As discussed above, the currency handling system utilizes flow control to track the movement of each individual bill through the currency handling device 100 as well as to detect the occurrence of bill jams within the currency handling device 100.  
20 Utilizing flow control not only allows the device 100 to more quickly detect bill jams, but also enables the device 100 to implement a bill jam reconciliation procedure which results in a significant time savings over the prior art. During normal operation, a processor in conjunction with the plurality of sensors 119 disposed along the transport mechanism 104 tracks each of the currency bills transported through the currency  
25 handling device 100 from the evaluation region 108 to the escrow regions 116. Accordingly, the processor monitors the number of bills that have, for example, advanced from the input receptacle 102 through the evaluation unit 108, the number of bills stacked in each of the escrow regions 116a-f, and the number of bills moved into the storage cassettes 118a-f. The device 100 maintains separate counts of the number  
30 of bills delivered into each escrow region 116 and each of the storage cassettes 118. As bills are moved from an escrow region 116 to a corresponding storage cassette 118 the total number of bills being moved is added to the total number of bills in the storage cassette 118.

Upon the detection of a bill jam occurring in the transport mechanism 104, the processor has maintained an accurate count of the number of bills which have already been transported into each escrow region 116. The integrity of the bill count is maintained because the flow control routine rapidly determines the presence of a bill jam within the transport mechanism 104. Again, as discussed above, if a bill does not pass the next sensor 119 within a predetermined number of encoder counts, the operation of the transportation mechanism 104 is suspended and the user is alerted of the error. Because the transporting of bills is suspended almost immediately upon failure of a bill to pass a sensor 119 within a specific timeframe (*e.g.* number of encoder counts) thus preventing the pile-up of bills, the processor “knows” the specific location of each of the bills within the device 100 because the operation of the device is suspended before bills are allowed to pile up.

Because of the almost immediate suspension of the transporting of bills, the integrity of the counts of the bills in the escrow regions 116 and the storage cassettes 118 are maintained. Before the system is flushed, the bills within each of the escrow regions 116 are downwardly transported from the escrow regions 116 to the corresponding storage cassettes 118. If the bill jam occurs in one of the escrow regions 116, bills located in other escrow regions 116 where the bill jam has not occurred are transported to the respective storage cassettes 118.

In one embodiment of the currency evaluation device 10, the user is notified via the user interface 122 of the occurrence of a bill jam and the suspension of the transporting of bills. The user is prompted as to whether the bills in the escrow regions 116 should be moved to the storage cassettes 118. In other embodiments of the currency handling device, those bills already in the escrow regions are automatically moved to the storage cassettes upon detection of a bill jam. The user is directed, via the user interface 122, to the proximate location of the bill jam in the transport mechanism 104. If necessary, the user can electronically jog the transport mechanism 104, as described above, to facilitate the manual removal of the bill jam. After clearing the bill jam and causing those bill already transported into the escrow regions 116 to be moved into the corresponding storage cassettes 118, the user is prompted to flush the bills currently within the transport mechanism 104. Flushing the bills causes those bills still remaining in the transport mechanism 104 to be transported to one of the escrow

regions 116. After the remaining bills are flushed from the transport mechanism 116, the operator can remove the flushed bills from the escrow region 116 for reprocessing.

Referring now to FIG. 19, the operation of the bill jam reconciliation process will be described in connection with the illustrated functional block diagram of the currency handling device 100. Pursuant to the user's selected mode of operation, currency bills are transported from the input receptacle 102 through the evaluation region 108 to one of the plurality of output receptacles 106a-h. According to some modes of operation, some of the currency bills are also transported through the bill facing mechanism 110 in those embodiments of the currency handling device 100 which implementing a bill facing mechanism 110. As each of the bills are transported thorough the currency handling device 100 by the transport mechanism 104, a processor, in connection with the plurality of bill passage sensors 119, tracks the movement of each of the bills from the evaluation region 106 to each of the escrow regions 116a-f pursuant to the flow control process discussed above. As bills are delivered into each of the escrow regions 116a-f, an escrow region bill counter 202 ("ER Count" in FIG. 19) assigned to each escrow region 116 maintains a count of the number of bills transported into each escrow region 116. After a predetermined number of bills have been transported into an escrow region 116, the operation of the transport mechanism is temporarily suspended while the bills are moved from the escrow region 116 to the corresponding storage cassette 118. A storage cassette counter 204 ("SC Count" in FIG. 19) corresponding to each storage cassette 118, maintains a count of the total number of bills moved into a storage cassette. Upon moving bills from the escrow region 116 to the corresponding storage cassette 118, the escrow region count is added to the storage cassette count. After adding the escrow region count and the storage cassette count, the escrow region counter 202 is reset to zero and the operation of the transport mechanism is resumed.

Upon detection of the occurrence of a bill jam, the operation of the transport mechanism 104 is suspended. At the time of the occurrence of a bill jam, each of the escrow regions have as many as two hundred fifty bills or as little as zero bill transported therein. A count of the specific number of bills in each of the escrow regions 116a-f is maintained by each of the escrow region counters 202a-f. In response to user input, the bills within the escrow regions 116 are moved from the escrow regions 116 to the storage cassettes 118 and the escrow bill count 202 is added



to the storage cassette bill count 204. The operator of the currency handling device 100 can then clear the bill jam and flush the remaining bill from the transport mechanism 104 as discussed above. If the bill jam has occurred in one of the escrow regions 116, the bills in the remaining escrow regions 116 not having bill jams detected therein are moved to the corresponding storage cassettes 118. Those bill already transported into the escrow region 116 having the bill jam detected therein are reprocessed along with the bills flushed from the transport mechanism 104.

The ability of the currency handling device 100 to transport those bill already processed into the escrow regions 116 and into the storage cassettes 118 while maintaining the integrity of the bill counts 202,204 with respect to each output receptacle 106c-h is a significant improvement resulting in appreciable time savings over prior art devices. In prior art devices, upon the occurrence of a bill jam, the operator would have to clear the bill jam and manually turn a hand crank to move the remaining bills from the transport path into the escrowing regions. Prior art devices do not maintain separate running totals as bills pass various points within the device. For example, a prior device may only count the bills as they are transported through an evaluation region of the currency handing machine. Bills exiting the evaluation region are included in the totals regardless of whether they are involved in bill jams or are successfully transported to an output receptacle. Therefore, when a bill jam occurs, those bills involved in the bill jam as well as those bills already transported to the output receptacles have to be reprocessed. Other prior art devices having both holding areas and storage areas only maintain a count of the number of bill in the storage areas, but not a count of the number of bills in the holding areas.

Reprocessing all of the bills already transported into the holding areas is a time consuming process as the number of bills to be re-processed can be voluminous. In the present device for example, each of the escrow regions 116 can accommodate approximately 250 bills. Six escrow regions presents the possibility of having to reprocess up to 1500 bills upon the occurrence of a bill jam. The problem is further exasperated when modular lower output receptacles 106 are added. For example, the addition of eight modular lower output receptacles 106 brings the total number of lower output receptacles 106 to fourteen, thus up to 3500 bills would have to be reprocessed. The inefficiencies associated with this procedure arise from the loss of productivity while the device 100 is stopped and the time required to remove the

stacks of bills from the escrow regions 116 as well as the time required to re-process the bills pulled from the escrow regions 116.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and herein described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

**CLAIMS:**

1. A currency handling device for rapidly processing a plurality of currency bills, the device comprising:

an input receptacle adapted to receive stacks of bills to be processed;

5 a plurality of output receptacles adapted to receive the bills after the bills have been evaluated, at least one of the output receptacles including a holding area and a storage area;

a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle into the holding areas;

10 an evaluating unit adapted to determine information concerning the bills, the evaluation unit including at least one evaluating sensor positioned along the transport path between the input receptacle and the plurality of output receptacles;

a plurality of bill passage sensors sequentially disposed along the transport path, each of the plurality of sensors being adapted to detect the passage of a bill as  
15 each bill is transported past each sensor;

a controller being adapted to track the movement of bills along the transport path, the controller adapted to separately maintain a count of the number of bills transported to the each of the holding areas and each of the storage areas, the controller being adapted to detect the presence of a bill jam and suspend operation of the transport mechanism when a  
20 bill is not transported past one of the plurality of bill passage sensors within a predetermined amount of time.

2. The currency handling device of claim 1 wherein the controller is adapted to cause the bills in each of the holding areas to be moved to the corresponding storage  
25 area after detection of a bill jam.

3. The currency handling device of claim 2 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller adapted to prompt the user for input before causing the bills in each of the  
30 holding areas to be moved to the corresponding storage areas after a bill jam is detected, the controller adapted move the bills in the holding areas to the corresponding storage areas in response to user input.

4. The currency handling device of claim 2 wherein the controller is adapted to update the count of the number of bills transported into a storage area by adding thereto the count of the number of bills transported into the corresponding holding area prior to causing the bills in the holding area to be moved to the corresponding storage area.

5

5. The currency handling device of claim 4 wherein the controller is adapted to reset the count of the number of bills transported into the holding area after causing the bills in each of the holding areas to be moved to the corresponding storage area.

10

6. The currency handling device of claim 2 wherein the controller is adapted to cause the transport mechanism to flush the bills from the transport path after the bills in each of the holding areas are moved to the corresponding storage areas.

15

7. The currency handling device of claim 6 further comprising a user interface adapted to receive input from a user of the currency handling device, wherein the controller is adapted to prompt the user as whether to flush the bills, the controller being adapted to cause the transport mechanism to flush the bills in response to user input.

20

8. The currency handling device of claim 2 wherein the controller is adapted to detect the presence of a bill jam in the holding areas, the controller adapted to suspend operation of the transport mechanism upon the detection of a bill jam in one of the holding areas, the controller being adapted to cause the bills in each of the holding areas not having a bill jam detected therein to be moved to the corresponding storage areas upon detection of a bill jam.

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30

9. The currency handling device of claim 8 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller adapted to prompt the user for input before causing the bills in each of the holding areas not having a bill jam detected therein to the corresponding storage areas, the controller adapted move the bills in each of the holding areas not having bill jams detected therein to the corresponding storage areas in response to user input.

10. The currency handling device of claim 9 wherein the controller is adapted to prompt the user as whether to flush the bills, the controller being adapted cause the transportation mechanism to flush the bills in response to user input.

5 11. The currency handling device of claim 9 wherein the controller is adapted to electronically jog the transport mechanism to facilitate the clearing of the bill jam in response to user input via the user interface.

12. The currency handling device of claim 1 wherein the device is adapted to  
10 process bills at a rate of at least about 800 bills per minute.

13. The currency handling device of claim 1 wherein the device is adapted to process bills at a rate of at least about 1500 bills per minute

15 14. The currency handling device of claim 1 wherein each of the output receptacles including a holding area and a storage area further include a paddle adapted to move the bills from the holding area to the corresponding storage areas.

15. The currency handling device of claim 1 further comprising:  
20 a bill facing mechanism disposed along the transport path between the evaluation region and the plurality of output receptacles, the bill facing mechanism being adapted to rotate a bill approximately 180°;

a plurality of bill passage sensors sequentially disposed along the bill facing mechanism; and

25 wherein the controller is adapted to detect a bill jam within the bill facing mechanism.

16. The currency handling device of claim 1 further comprising an encoder adapted to generate an encoder count for each incremental movement of the transport  
30 mechanism.

17. A currency handling device for rapidly processing a plurality of currency bills, the device comprising:

an input receptacle adapted to receive stacks of bills to be processed;

a plurality of output receptacles adapted to receive the bills after the bills have been evaluated, at least two of the output receptacles including a holding area and a storage area;

a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle into the holding areas;

an evaluating unit adapted to determine information concerning the bills, the evaluation unit including at least one evaluating sensor positioned along the transport path between the input receptacle and the plurality of output receptacles;

a plurality of bill passage sensors sequentially disposed along the transport path, each of the plurality of sensors being adapted to detect the passage of a bill as each bill is transported past each sensor;

an encoder adapted to produce an encoder count for each incremental movement of the transport mechanism; and

a controller being adapted to track the movement of bills along the transport path, the controller adapted to separately maintain a count of the number of bills transported to each of the holding areas and each of the storage areas, the controller being adapted to detect the presence of a bill jam and suspend operation of the transport mechanism when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts

18. The currency handling device of claim 17 wherein the controller is adapted to cause the bills in each of the holding areas to be moved to the corresponding storage area after detection of a bill jam.

19. The currency handling device of claim 18 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller adapted to prompt the user for input before causing the bills in each of the holding areas to be moved to the corresponding storage areas after a bill jam is detected, the controller adapted move the bills in the holding areas to the corresponding storage areas in response to user input.

20. The currency handling device of claim 18 wherein the controller is adapted to update the count of the number of bills transported into a storage area by adding thereto the count of the number of bills transported into the corresponding holding area prior to causing the bills in the holding area to be moved to the corresponding storage area.

5

21. The currency handling device of claim 20 wherein the controller is adapted to reset the count of the number of bills transported into the holding area after causing the bills in each of the holding areas to be moved to the corresponding storage area.

10

22. The currency handling device of claim 18 wherein the controller is adapted to cause the transport mechanism to flush the bills from the transport path after causing the bills in each of the holding areas to be moved to the corresponding storage area after detection of a bill jam.

15

23. The currency handling device of claim 22 further comprising a user interface adapted to receive input from a user of the currency handling device, the being controller is adapted to prompt the user as whether to flush the bills, the controller being adapted to cause the transport mechanism to flush the bills in response to user input.

20

24. The currency handling device of claim 1 wherein the controller is adapted to detect the presence of a bill jam in the holding areas, the controller adapted to suspend operation of the transport mechanism upon the detection of a bill jam in one of the holding areas, the controller being adapted to cause the bills in each of the holding areas not having a bill jam detected therein to be moved to the corresponding storage areas upon detection of a bill jam.

25

25. The currency handling device of claim 24 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller adapted to prompt the user for input before causing the bills in each of the holding areas not having a bill jam detected therein to be moved to the corresponding storage areas, the controller adapted move the bills in each of the holding areas not having bill jams detected therein to the corresponding storage areas in response to user input.

30

26. The currency handling device of claim 24 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller being adapted to prompt the user as whether to flush the bills, the controller being adapted to cause the transport mechanism to flush the bills from the transport path in response to user input.

27. The currency handling device of claim 1 wherein the controller is adapted to electronically jog the transport mechanism to facilitate clearing of the bill jam in response to user input via a user interface.

28. The currency handling device of claim 1 wherein the device is adapted to process bills at a rate of at least about 800 bills per minute.

29. The currency handling device of claim 1 wherein the device is adapted to process bills at a rate of at least about 1500 bills per minute.

30. The currency handling device of claim 1 further comprising:  
a bill facing mechanism disposed along the transport path between the evaluation region and the plurality of output receptacles, the bill facing mechanism being adapted to rotate a bill approximately 180°;  
a plurality of bill passage sensors sequentially disposed along the bill facing mechanism; and  
wherein the controller is adapted to detect a bill jam within the bill facing mechanism.

31. The currency handling device of claim 1 wherein each of the output receptacles including a holding area and a storage area further include a paddle adapted to move the bills from the holding area to the corresponding storage area.

32. A method for processing currency bills with a currency handling device, the method comprising:  
receiving a plurality of bills in an input receptacle;



transporting the bills with a transport mechanism, one at a time, from the input receptacle along a transport path into a plurality of output receptacles, at least one of the plurality of the output receptacles including a holding area and a storage area;  
determining information concerning the bills with an evaluating unit;  
5 maintaining a count of the total number of bills transported into each of the holding areas;  
moving the bills transported into each of the holding areas into a corresponding storage area after a predetermined number of bills have been stacked in the holding area;  
maintaining a count of the total number of bills moved into each of the storage  
10 areas;  
tracking the movement of each of the bills along the transport path; and  
detecting the presence of a bill jam when a bill is not transported past a predetermined position along the transport path within a predetermined amount of time.

15 33. The method of claim 32 further comprising suspending operation of the transport mechanism upon detection of a bill jam.

20 34. The method of claim 33 further comprising moving the bills already transported into each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.

25 35. The method of claim 34 further comprising updating the count for each of the storage areas of the number of bills moved into each of the storage areas by adding thereto the count of the number of bills transported into the corresponding holding areas prior to moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.

30 36. The method of claim 35 further comprising resetting the count of the total number of bills transported into each of the holding areas

37. The method of claim 34 further comprising receiving input from a user of the currency handling device via a user interface, the input including operational instructions, and wherein moving the bills already transported into each of the holding

areas to the corresponding storage areas further comprises moving the bills already transported into each of the holding areas to the corresponding storage areas after suspension of the operation of the transport mechanism in response to user input.

5           38.     The method of claim 34 further comprising flushing the bills from the transport path after moving the bills already transported into each of the holding areas to the corresponding storage areas.

10           39.     The method of claim 38 further comprising receiving input from a user of the currency handling device via a user interface, the input including operational instructions, and wherein flushing the bills further comprises flushing the bills in response to user input.

15           40.     The method of claim 34 further comprising detecting the presence of a bill jam in one of the holding areas when a bill is not transported past a predetermined position within the holding area within a predetermined amount of time, and wherein moving the bills already transported into each of the holding areas further comprises moving the bills already transported into each of the holding areas not having a bill jam detected therein to the corresponding storage areas upon suspension of the operation of the transport mechanism.

20           41.     The method of claim 40 further comprising receiving input from a user of the device via a user interface, the input including operational instructions, and wherein moving the bills already transported into each of the holding areas not having a bill jam detected therein further comprises moving the bills already transported into each of the holding areas not having a bill jam detected therein to the corresponding storage areas upon suspension of the operation of the transport mechanism in response to user input.

25           42.     The method of claim 41 further comprises flushing the bills from the transport path after moving the bills already transported into the holding areas upon suspension of the operation of the transport mechanism in response to user input.

43. The method of claim 41 wherein determining information further comprises determining information concerning the bills with an evaluating unit at a rate of at least about 800 bills per minute.

5           44. The method of claim 41 wherein determining information further comprises determining information concerning the bills with an evaluating unit at a rate of at least about 1500 bills per minute.

          45. The method of claim 41 further comprising:  
10           reversing the face orientation of a bill where the face orientation of a bill does not match a target orientation with a bill facing mechanism;  
          sequentially disposing a plurality of bill passage sensors along the bill facing mechanism; and  
          detecting the presence of a bill jam in the bill facing mechanism when a bill is not  
15           transported past one of the plurality of bill passage sensors within a requisite number of encoder counts.

          46. The method of claim 41 wherein transporting the bills further comprises stacking the bills in each of the holding areas.

20           47. The method of claim 41 wherein tracking the movement of each of the bills further comprises tracking the movement of each of the bills along the transport path with a plurality of bill passage sensors, each of the plurality of sensors being adapted to detect the passage of a bill as each bill is transported past each sensor.

25           48. The method of claim 47 further comprising generating an encoder count for each incremental movement of the transport mechanism.

          49. The method of claim 48 further comprising detecting the presence of a bill  
30           jam when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts.

50. A method of handling bill jams within a currency processing device, the device including a transport mechanism adapted to transport bills along a transport path, one at a time, from the input receptacle past an evaluation unit into a plurality of output receptacles, at least two of the plurality of the output receptacles including a holding area and a storage area, the device having a plurality of bill passage sensors sequentially disposed along the transport path, each of the plurality of sensors being adapted to detect the passage of a bill as each bill is transported past each sensor, the method comprising:

maintaining a separate count for each of the holding areas of the number of bills transported into each of the holding areas;

moving the bills from a holding area to a corresponding storage area after a predetermined number of bills have been transported into the holding area;

maintaining a separate count for each of the storage areas of the number of bills moved into each of the storage areas;

tracking the movement of each of the bills along the transport path into each of the holding areas with the plurality of bill passage sensors;

generating an encoder count for each incremental movement of the transport mechanism;

detecting the presence of a bill jam when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts;

suspending operation of the transport mechanism upon detection of a bill jam;

moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism;

updating the count for each of the storage areas of the number of bills moved into each of the storage areas by adding thereto the count of the number of bills transported into the corresponding holding areas prior to moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism; and

resetting the count of the total number of bills transported into each of the holding areas.

51. The method of claim 50 further comprising electronically jogging the transport mechanism.

52. The method of claim 51 further comprising flushing the bills from the transport path after moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.
53. The method of claim 51 further comprising manually clearing the bill jam from the transport path.
54. The method of claim 53 further comprising flushing the bills from the transport path after moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.
55. The method of claim 50 further comprising manually clearing the bill jam from the transport path.
56. The method of claim 55 further comprising flushing the bills from the transport path after moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.
57. The method of claim 50 further comprising receiving input from a user of the device via a user interface, the input including operational instructions, and wherein moving the bills already transported into each of the holding areas to the corresponding storage areas further comprises moving the bills already transported into each of the holding areas to the corresponding storage areas after suspension of the operation of the transport mechanism in response to user input.
58. The method of claim 57 wherein flushing the bills further comprises flushing the bills from the transport path after moving the bills already transported into the holding areas upon suspension of the operation of the transport mechanism in response to user input.
59. The method of claim 50 further comprising detecting the presence of a bill jam in one of the holding areas when a bill is not transported past one of the plurality

of bill passage sensors disposed adjacent the holding area within a requisite number of encoder counts, and wherein moving the bills already transported into each of the holding areas further comprises moving the bills already transported into each of the holding areas not having a bill jam detected therein to the corresponding storage areas upon suspension  
5 of the operation of the transport mechanism.

60. The method of claim 59 further comprising receiving input from a user of the device via a user interface, the input including operational instructions, and wherein moving the bills already transported into each of the holding areas not having a bill  
10 jam detected therein further comprises moving the bills already transported into each of the holding areas not having a bill jam detected therein to the corresponding storage areas upon suspension of the operation of the transport mechanism in response to user input.

61. The method of claim 60 wherein flushing the bills further comprises  
15 flushing the bills from the transport path after moving the bills already transported into the holding areas upon suspension of the operation of the transport mechanism in response to user input.

62. The method of claim 50 wherein determining information further  
20 comprises determining information concerning the bills with an evaluating unit at a rate of at least about 800 bills per minute.

63. The method of claim 50 wherein determining information further  
25 comprises determining information concerning the bills with an evaluating unit at a rate of at least about 1500 bills per minute.

64. The currency handling device of claim 50 further comprising:  
reversing the face orientation of a bill where the face orientation of a bill does not  
match a target orientation with a bill facing mechanism;  
30 sequentially disposing a plurality of bill passage sensors along the bill facing mechanism; and

detecting the presence of a bill jam in the bill facing mechanism when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts.

**ABSTRACT**

A method and apparatus for handling bill jams within a currency processing device is provided. The device includes a transport mechanism adapted to transport bills along a transport path, one at a time, from the input receptacle past an evaluation unit into a plurality of output receptacles. At least one of the output receptacles includes a holding area and a storage area. A plurality of bill passage sensors are sequentially disposed along the transport path that are adapted to detect the passage of a bill as each bill is transported past each sensor. An encoder is adapted to produce an encoder count for each incremental movement of the transport mechanism. A controller counts the total number of bills transported into each of the holding areas and the total number of bills moved from a holding area to a corresponding storage area after a predetermined number of bills have been transported into the holding area. The controller tracks the movement of each of the bills along the transport path into each of the holding areas with the plurality of bill passage sensors. The presence of a bill jam is detected when a bill is not transported past one of the plurality of bill passage sensors within a requisite number of encoder counts. The operation of the transport mechanism is suspended upon detection of a bill jam. The bills from each of the holding areas are moved to the corresponding storage areas upon suspension of the operation of the transport mechanism. Remaining bills are then flushed from the transport path after moving the bills from each of the holding areas to the corresponding storage areas upon suspension of the operation of the transport mechanism.



**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of:

Charles P. Jenrick et al.

Atty. Docket No.: 47171-00246USP2

Serial No.: 09/688,538

Group Art: 3652

Filed: October 16, 2000

Examiner: Not Assigned

Title: CURRENCY HANDLING  
SYSTEM HAVING MULTIPLE  
OUTPUT RECEPTACLES

**PRELIMINARY AMENDMENT "C"**

COMMISSIONER FOR PATENTS  
WASHINGTON, D.C. 20231

**CERTIFICATE OF MAILING**  
37 C.F.R. 1.8

I hereby certify that this correspondence is being deposited with the U.S. Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, Washington, D.C., on the date indicated below:

May 2, 2002  
Date

  
Adrienne White

Dear Commissioner:

Prior to the examination of the above-captioned patent applications, Applicants respectfully request that this Preliminary Amendment "C" be entered.

**IN THE CLAIMS:**

Please amend claims 7, 14 and 30 as follows:

7. (Amended) The currency handling device of claim 6 [further] wherein the user interface is adapted to receive input from a user specifying which of the plurality of output receptacles is the alternative output receptacle.

14. (Twice Amended) The [currency handling device] method of claim 13 wherein the alternative output receptacle is the output receptacle to which no call bills are transported pursuant to the selected mode of operation.

30. (Amended) The [currency handling device] method of claim 29 wherein the alternative output receptacle is the output receptacle to which no call bills are transported pursuant to the selected mode of operation.


**REMARKS**

Claims 1-32 are pending in the present application. Claims 7, 14 and 30 have been amended to correct simple typographical errors contained in the application as originally filed. These amendments do not alter the scope of these claims. In accordance with current practice under 37 C.F.R. § 1.121, a clean version of the pending claims is attached and captioned as "Clean Version Of Pending Claims Incorporating Amendments Made Pursuant To Preliminary Amendment 'C'."

If there are any matters which may be resolved or clarified through a telephone interview, the Examiner is respectfully requested to contact Applicants' undersigned attorney at the number indicated.

It is believed that no fee is presently due; however, should any additional fees be required (except for payment of the issue fee), the Assistant Commissioner is authorized to deduct the fees from Jenkins & Gilchrist, P.C. Deposit Account No. 10-0447, Order No. 47171-00246USP2.

Respectfully submitted,



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ATTORNEYS FOR APPLICANTS

Date: May 2, 2002

**CLEAN VERSION OF PENDING CLAIMS INCORPORATING AMENDMENTS  
MADE PURSUANT TO PRELIMINARY AMENDMENT "C"**

1. A currency handling device for rapidly processing a plurality of currency bills, the device comprising:
  - an input receptacle adapted to receive the currency bills to be processed;
  - a plurality of output receptacles adapted to receive the bills after the bills have been evaluated;
  - a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the plurality of output receptacles;
  - an evaluating unit adapted to determine information concerning the bills, the evaluating unit including at least one sensor positioned along the transport path; and
  - a controller adapted to operate the currency handling device according to a mode of operation wherein the mode of operation designates the output receptacle to which each of the bills are to be transported based on determined information concerning the bill, the controller being adapted to disable at least one of the plurality of output receptacles, the controller being adapted to cause the transport mechanism to redirect bills directed to the disabled one of the plurality of output receptacles pursuant to the mode of operation to an alternative output receptacle.
2. The currency handling device of claim 1 wherein the controller is adapted to detect the presence of an error condition in at least one of the plurality of output receptacles.
3. The currency handling device of claim 2 wherein the controller is adapted to disable an output receptacle having an error condition detected therein.
4. The currency handling device of claim 3 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller being adapted to disable an output receptacle having an error condition detected therein in response to user input.
5. (Amended) The currency handling device of claim 4 further comprising a user interface adapted to receive input from a user of the currency handling device selecting the mode of operation from a plurality of modes of operation.

6. The currency handling device of claim 1 comprising a user interface adapted to receive input from a user specifying the output receptacles to be disabled.
7. (Amended) The currency handling device of claim 6 wherein the user interface is adapted to receive input from a user specifying which of the plurality of output receptacles is the alternative output receptacle.
8. The currency handling device of claim 1 wherein the alternative output receptacle is the output receptacle to which no call bills are transported pursuant to the mode of operation.
9. A method of processing a plurality of currency bills with a currency handling device, the method comprising:
  - disabling at least one of a plurality of output receptacles;
  - receiving a plurality of currency bills in an input receptacle;
  - transporting the bills with a transport mechanism, one at a time, from the input receptacle past an evaluating area to the plurality of output receptacles;
  - determining information concerning each of the bills with an evaluating unit;
  - designating the particular one of the plurality of output receptacles to which each of the bills are transported based on the determined information concerning each of the bills;
  - comparing the designated output receptacle for each of the bills to the disabled output receptacle; and
  - re-designating the particular one of the plurality of output receptacles to which each of the bills are transported to an alternative output receptacle when the designated output receptacle is the disabled output receptacle.
10. The method of claim 9 further comprising detecting the presence of an error condition within the plurality of output receptacles.
11. The method of claim 10 wherein disabling further comprises disabling the output receptacle having an error condition detected therein.

12. The method of claim 11 wherein the currency handling device includes a user interface, and wherein disabling further comprises disabling the output receptacle having an error condition detected therein in response to user input.
13. The method of claim 9 further comprising receiving input from a user of the currency handling device selecting a mode of operation from a plurality of modes of operation stored within a memory of the currency handling device, wherein the mode of operation designates the one of the plurality of output receptacles to which each of the bills are transported based on the determined information concerning the bill.
14. (Twice Amended) The method of claim 13 wherein the alternative output receptacle is the output receptacle to which no call bills are transported pursuant to the selected mode of operation.
15. The method of claim 9 further comprising receiving input from a user of the currency handling device specifying the particular one of the plurality of output receptacles to be disabled.
16. The method of claim 9 further comprising receiving input from a user of the currency handling device specifying which of the plurality of output receptacles is the alternative output receptacle.
17. A method of processing a plurality of currency bills with a currency handling device, the currency handling device including a transport mechanism adapted to transport each of the bills, one at a time, from an input receptacle past an evaluation unit to a plurality of output receptacles, the currency handling device includes a user-interface adapted receive input from a user of the currency handling device, the method comprising:
  - disabling at least one of a plurality of output receptacles;
  - receiving a plurality of currency bills;
  - transporting the bills from the input receptacle past the evaluating unit to the plurality of output receptacles;
  - determining information concerning each of the bills;
  - designating the particular one of the plurality of output receptacles to which each of the bills are transported based on the determined information concerning each of the bills;

comparing the designated output receptacle for each of the bills to the disabled output receptacle; and

re-designating the particular one of the plurality of output receptacles to which each of the bills are transported to an alternative output receptacle when the designated output receptacle is the disabled output receptacle.

18. The method of claim 17 further comprising detecting the presence of an error condition within the plurality of output receptacles.

19. The method of claim 18 wherein disabling further comprises disabling the output receptacle having an error condition detected therein.

20. The method of claim 19 further comprising disabling the output receptacle having an error condition detected there in response to user input.

21. The method of claim 17 further comprising receiving input from a user of the currency handling device selecting a mode of operation from a plurality of modes of operation stored within a memory of the currency handling device, wherein the mode of operation designates to the output receptacle to which each of the bills are transported based on the determined information concerning the bill.

22. The currency handling device of claim 21 wherein the alternative output receptacle is the output receptacle to which no call bills are transported pursuant to the selected mode of operation.

23. The method of claim 17 further comprising receiving input from a user of the currency handling device specifying the particular one of the plurality of output receptacles to be disabled.

24. The method of claim 17 further comprising receiving input from a user of the currency processing device specifying which of the plurality of output receptacles is the alternative output receptacle.

25. A method of processing a plurality of currency bills with a currency handling device, the currency handling device including a transport mechanism adapted to transport each of the bills, one at a time, from an input receptacle past an evaluation unit to a plurality of output receptacles, the currency handling device includes a user-interface adapted receive input from a user of the currency handling device, the method comprising:

- disabling at least one of a plurality of output receptacles;
- updating at least one output receptacle designation of a mode of operation to direct those bills designated to be delivered to the at least one disabled output receptacle to an alternative output receptacle;
- receiving a plurality of currency bills;
- transporting the bills from the input receptacle past the evaluating unit to the plurality of output receptacles;
- determining information concerning each of the bills; and
- designating the particular one of the plurality of output receptacles to which each of the bills are transported based on the determined information concerning each of the bills;

26. The method of claim 25 further comprising detecting the presence of an error condition within the plurality of output receptacles.

27. The method of claim 26 wherein disabling further comprises disabling the output receptacle having an error condition detected therein.

28. The method of claim 27 further comprising disabling the output receptacle having an error condition detected there in response to user input.

29. The method of claim 25 further comprising receiving input from a user of the currency handling device selecting a mode of operation from a plurality of modes of operation stored within a memory of the currency handling device, wherein the mode of operation designates to the output receptacle to which each of the bills are transported based on the determined information concerning the bill.

30. (Amended) The method of claim 29 wherein the alternative output receptacle is the output receptacle to which no call bills are transported pursuant to the selected mode of operation.

31. The method of claim 25 further comprising receiving input from a user of the currency handling device specifying the particular one of the plurality of output receptacles to be disabled.

32. The method of claim 25 further comprising receiving input from a user of the currency processing device specifying which of the plurality of output receptacles is the alternative output receptacle.



JENKENS &amp; GILCHRIST, P.C.

PATENT

Customer No. 23,932

Atty. Docket No. 47171-00246USP2

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**APPLICATION FOR UNITED STATES LETTERS PATENT****FOR****CURRENCY HANDLING SYSTEM HAVING  
MULTIPLE OUTPUT RECEPTACLES****BY****Charles P. Jenrick;****Robert J. Klein; and****Curtis W. Hallowell.**

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I hereby certify that this paper or fee is being deposited with the United States Postal Service "EXPRESS MAIL POST OFFICE TO ADDRESSEE" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to: Assistant Commissioner for Patents, Washington D.C. 20231.	
<u>Margaret Miller Hammonds</u> Name	

## **CURRENCY HANDLING SYSTEM HAVING MULTIPLE OUTPUT RECEPTACLES**

### **CROSS-REFERENCE TO RELATED APPLICATIONS**

5           The application is a continuation-in-part of U.S. Patent Application Serial  
Number 09/502,666 entitled "Currency Handling System Having Multiple Output  
Receptacles," which was filed on February 11, 2000 and is assigned to the assignee of  
the present application.

### **FIELD OF THE INVENTION**

10           The present invention relates generally to the field of currency handling systems  
and, more particularly, to a multi-pocket currency handling system for discriminating,  
authenticating, and/or counting currency bills.

### **BACKGROUND OF THE INVENTION**

15           A variety of techniques and apparatuses have been used to satisfy the requirements  
of automated currency handling machines. As businesses and banks grow, these businesses  
are experiencing a greater volume of paper currency. These businesses are continually  
requiring not only that their currency be processed more quickly but, also, processed with  
20           more options in a less expensive manner. At the upper end of sophistication in this area of  
technology are machines that are capable of rapidly identifying, discriminating, and  
counting multiple currency denominations and then delivering the sorted currency bills into  
a multitude of output compartments. Many of these high end machines are extremely large  
and expensive such that they are commonly found only in large institutions. These  
25           machines are not readily available to businesses which have monetary and space budgets,  
but still have the need to process large volumes of currency. Other high end currency  
handling machines require their own climate controlled environment which may place even  
greater strains on businesses having monetary and space budgets.

30           Currency handling machines typically employ magnetic sensing or optical sensing  
for denominating and authenticating currency bills. The results of these processes  
determines to which output compartment a particular bill is delivered to in a currency  
handling device having multiple output receptacles. For example, ten dollar denominations  
may be delivered to one output compartment and twenty dollar denominations to another,

while bills which fail the authentication test are delivered to a third output compartment. Unfortunately, many prior art devices only have one output compartment which can be appropriately called a reject pocket. Accordingly, in those cases, the reject pocket may have to accommodate those bills which fail a denomination test or authentication test. As a  
5 result, different types of "reject" bills are stacked upon one another in the same output compartment leaving the operator unknowing as to which of those bills failed which tests.

During the lifetime of prior art currency handling devices it is likely that individual key components of the devices, including components specific to the output receptacles, will degrade and eventually fail. The failure of an individual components  
10 specific to an output receptacle can render that output receptacle inoperable. The inoperability of one of the output receptacles of prior art currency handling devices can render the entire device inoperable regardless of whether the remaining output receptacles are otherwise properly functioning. Component failures resulting in the inoperability of the entire device can have a devastating effect on the cash handling  
15 operations of users of these devices. The inventors of the present invention have found that currency handling devices play a vital role in the overall operation of a cash vault, including cash vaults at bank or casinos. The inventors estimate that over 90% (ninety percent) of the cash handled within a cash vault is processed by a currency handling device. Therefore, the failure of a currency handling device can have a disastrous  
20 effect on the operation of a cash vault or other operations relying on the performance of the currency handling device.

#### **SUMMARY OF THE INVENTION**

A currency handling device for rapidly processing a plurality of currency bills  
25 comprises an input receptacle adapted to receive the currency bills to be processed, a plurality of output receptacles adapted to receive the bills after the bills have been processed, a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the plurality of output receptacles, an evaluating unit that is adapted to determine information concerning the bills, and a  
30 controller. The evaluation unit includes at least one sensor positioned along the transport path between the input receptacle and the plurality of output receptacles. The controller is adapted to operate the currency handling device according to a mode of operation wherein the mode of operation designates the output receptacle to which each of the bills are

transported based on the determined information concerning the bill. The controller is adapted to disable at least one of the plurality of output receptacles. The controller is adapted to cause the transport mechanism to direct bills directed to the disabled one of the plurality of output receptacles pursuant to the mode of operation to an alternative output receptacle.

The above summary of the present invention is not intended to represent each embodiment, or every aspect, of the present invention. Additional features and benefits of the present invention will become apparent from the detail description, figures, and claim set forth below.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Other objects and advantages of the invention will become apparent upon reading the following detailed description in conjunction with the drawings in which:

FIG. 1a is a perspective view of a document handling device according to one embodiment of the invention;

FIG. 1b is a front view of a document handling device according to one embodiment of the invention;

FIG. 2a is a perspective view of an evaluation region according to one embodiment of the document handling device of the present invention;

FIG. 2b is a side view of an evaluation region according to one embodiment of the document handling device of the present invention;

FIG. 3a is a perspective view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 3b is another perspective view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 3c is a top view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 3d is a side view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 4 is a perspective view of a portion of a transportation mechanism according to one embodiment of the present invention;

FIG. 5 is a front perspective view of an escrow compartment, a plunger assembly, and a storage cassette according to one embodiment of the document handling device of the present invention;

5 FIG. 6 is a top view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

FIG. 7 is a front view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

10 FIG. 8 is another front view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

FIG. 9 is a perspective view of an apparatus for transferring currency from an escrow compartment to a storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 10 is a perspective view of a paddle according to one embodiment of the document handling device of the present invention;

FIG. 11 is a rear perspective view of the escrow compartment, plunger assembly, and storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 12 is a rear view of a plunger assembly wherein the gate is in the open position according to one embodiment of the document handling device of the present invention;

FIG. 13 is a rear view of a plunger assembly wherein the gate is in the closed position according to one embodiment of the document handling device of the present invention;

FIG. 14 is a perspective view of a storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 15 is a rear view of a storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 16 is a perspective view of a storage cassette where the door is open according to one embodiment of the document handling device of the present invention;

FIG. 17a is a top view of a storage cassette sized to accommodate United States currency documents according to one embodiment of the document handling device of the present invention;

5 FIG. 17b is a rear view of a storage cassette sized to accommodate United States currency documents according to one embodiment of the document handling device of the present invention;

FIG. 18a is a top view of a storage cassette sized to accommodate large documents according to one embodiment of the document handling device of the present invention;

10 FIG. 18b is a rear view of a storage cassette sized to accommodate large documents according to one embodiment of the document handling device of the present invention;

FIG. 19 is a flow chart of the disable pockets routine according to one embodiment of the document handling device of the present invention; and

15 FIG. 20 is a flow chart of the disable pockets routine according to an alternative embodiment of the document handling device of the present invention

#### **DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS**

Referring to FIGS. 1a and 1b, a multi-pocket document processing device 100 such as a currency handling device according to one embodiment of the present invention is illustrated. Currency bills are fed, one by one, from a stack of currency bills placed in an input receptacle 102 into a transport mechanism 104. The transport mechanism 104 guides currency bills to one of a plurality of output receptacles 106a-106h, which may include upper output receptacles 106a, 106b, as well as lower output receptacles 106c-106h. Before reaching an output receptacle 106 the transport mechanism 104 guides the bill through an evaluation region 108 where a bill can be, for example, analyzed, authenticated, denominated, counted, and/or otherwise processed. In alternative embodiments of the currency handling device 100 of the present invention, the evaluation region 108 can determine bill orientation, bill size, or whether bills are stacked upon one another. The results of the above process or processes may be used to determine to which output receptacle 106 a bill is directed. The illustrated embodiment of the currency handling device has an overall width,  $W_1$ ,

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of approximately 4.52 feet (1.38 meters), a height,  $H_1$ , of approximately 4.75 feet (1.45 meters), and a depth,  $D_1$ , of approximately 1.67 feet (0.50 meters).

5 In one embodiment, documents such as currency bills are transported, scanned, denominated, authenticated and/or otherwise processed at a rate equal to or greater than 600 bills per minute. In another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated, and/or otherwise processed at a rate equal to or greater than 800 bills per minute. In another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated and/or otherwise processed at a rate equal to or greater than 1000 bills per minute. In still  
10 another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated, and/or otherwise processed at a rate equal to or greater than 1200 bills per minute.

In the illustrated embodiment, interposed in the bill transport mechanism 104, intermediate the bill evaluation region 108 and the lower output receptacles 106c-106h  
15 is a bill facing mechanism designated generally by reference numeral 110. The bill facing mechanism is capable of rotating a bill  $180^\circ$  so that the face position of the bill is reversed. That is, if a U.S. bill, for example, is initially presented with the surface bearing a portrait of a president facing down, it may be directed to the facing mechanism 110, whereupon it will be rotated  $180^\circ$  so that the surface with the portrait  
20 faces up. The leading edge of the bill remains constant while the bill is being rotated  $180^\circ$  by the facing mechanism 110. The decision may be taken to send a bill to the facing mechanism 110 when the selected mode of operation or other operator instructions call for maintaining a given face position of bills as they are processed by the currency handling device 100. For example, it may be desirable in certain  
25 circumstances for all of the bills ultimately delivered to the lower output receptacles 106c-106h to have the bill surface bearing the portrait of the president facing up. In such embodiments of the currency handling device 100, the bill evaluation region 108 is capable of determining the face position of a bill, such that a bill not having the desired face position can first be directed to the facing mechanism 110 before being  
30 delivered to the appropriate output receptacle 106. Further details of a facing mechanism which may be utilized for this purpose are disclosed in commonly-owned, U.S. Patent No. 6,047,334, incorporated herein by reference in its entirety, which may be employed in conjunction with the present invention such as the device illustrated in

FIGS. 1a and 1b. Alternatively, the facing mechanism disclosed in commonly-owned co-pending U.S. Application Serial No. 09/503,039, entitled "Two Belt Bill Facing Mechanism" which was filed on February 11, 2000, incorporated herein by reference in its entirety, may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b. Other alternative embodiments of the currency handling device 100 do not include the facing mechanism 110.

The currency handling device 100 in FIG. 1a may be controlled from a separate controller or control unit 120 which has a display/user-interface 122, which may incorporate a touch panel display in one embodiment of the present invention, which displays information, including "functional" keys when appropriate. The display/user-interface 122 may be a full graphics display. Alternatively, additional physical keys or buttons, such as a keyboard 124, may be employed. The control unit 120 may be a self-contained desktop or laptop computer which communicates with the currency handling device 100 via a cable 125. The currency handling device 100 may have a suitable communications port (not shown) for this purpose. In embodiments in which the control unit 120 is a desktop computer wherein the display/user-interface 122 and the desktop computer are physically separable, the desktop computer may be stored within a compartment 126 of the currency handling device 100. In other alternative embodiments, the control unit 120 is integrated into the currency handling device 100 so the control unit 120 is contained within the device 100.

The operator can control the operation of the currency handling device 100 through the control unit 120. Through the control unit 120 the operator can direct the bills into specific output receptacles 106a-106h by selecting various user defined modes. In alternative embodiments, the user can select pre-programmed user defined modes or create new user defined modes based on the particular requirements of the application. For example, the operator may select a user defined mode which instructs the currency handling device 100 to sort bills by denomination; accordingly, the evaluation region 108 would denominate the bills and direct one dollar bills into the first lower output receptacle 106c, five dollar bills into the second lower output receptacle 106d, ten dollar bills into the third lower output receptacle 106e, twenty dollar bills into the forth lower output receptacle 106f, fifty dollar bills into the fifth lower output receptacle 106g, and one-hundred dollar bills into the sixth lower output receptacle 106h. The operator may also instruct the currency handling device 100 to



deliver those bills whose denomination was not determined, no call bills, to the first upper output receptacle 106a. In such an embodiment, upper output receptacle 106a would function as a reject pocket. In an alternative embodiment, the operator may instruct the currency handling device 100 to also evaluate the authenticity of each bill.

5 In such an embodiment, authentic bills would be directed to the appropriate lower output receptacle 106c-106h. Those bills that were determined not to be authentic, suspect bills, would be delivered to the second upper output receptacle 106b. A multitude of user defined modes are disclosed by co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Multi-Pocket Currency Discriminator" which was filed  
10 on August 21, 1997, incorporated herein by reference in its entirety, which may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b.

According to one embodiment, the currency handling device 100 is designed so that when the evaluation region 108 is unable to identify certain criteria regarding a  
15 bill, the unidentified note is flagged and "presented" in one of the output receptacles 106a-106h, that is, the transport mechanism 104 is stopped so that the unidentified bill is located at a predetermined position within one of the output receptacles 106a-106h, such as being the last bill transported to one of the output receptacles. Such criteria can include denominating information, authenticating information, information  
20 indicative of the bill's series, or other information the evaluation region 108 is attempting to obtain pursuant to a mode of operation. Which output receptacles 106a-106h the flagged bill is presented in may be determined by the user according to a selected mode of operation. For example, where the unidentified bill is the last bill transported to an output receptacle 106a-106h, it may be positioned within a stacker  
25 wheel or positioned at the top of the bills already within the output receptacle 106a-106h. While unidentified bills may be transported to any output receptacles 106a-106h, it may be more convenient for the operator to have unidentified bills transported to one of the upper output receptacles 106a,b where the operator is able to easily see and/or inspect the bill which has not been identified by the evaluation region 108. The  
30 operator may then either visually inspect the flagged bill while it is resting on the top of the stack, or alternatively, the operator may decide to remove the bill from the output receptacle 106 in order to examine the flagged bill more closely. In an alternative embodiment of the currency handling device 100, the device 100 may communicate to

the user via the display/user-interface 122 in which one of the output receptacles 106a-106h a flagged bill is presented.

5 The currency handling device 100 may be designed to continue operation automatically when a flagged bill is removed from the upper output receptacle 106a,b or, according to one embodiment of the present invention, the device 100 may be designed to suspend operation and require input from the user via the control unit 120. Upon examination of a flagged bill by the operator, it may be found that the flagged bill is genuine even though it was not identified as so by the evaluation region 108 or the evaluation may have been unable to denominate the flagged bill. However, because  
10 the bill was not identified, the total value and/or denomination counters will not reflect its value. According to one embodiment, such an unidentified bill is removed from the output receptacles 106 and reprocessed or set aside. According to another embodiment, the flagged bills may accumulate in the upper output receptacles 106a,b until the batch of currency bills currently being processed is completed or the output  
15 receptacle 106a,b is full and then reprocessed or set aside.

According to another embodiment, when a bill is flagged, the transport mechanism may be stopped before the flagged bill is transported to one of the output receptacles. Such an embodiment is particularly suited for situations in which the operator need not examine the bill being flagged; for example, the currency handling  
20 device 100 is instructed to first process United States currency and then British currency pursuant to a selected mode of operation where the currency handling device 100 processes United States \$1, \$5, \$10, \$20, \$50, and \$100 currency bills into the lower output receptacles 106c-106h, respectively. Upon detection of the first British pound note, the currency handling device 100 may halt operation allowing the operator  
25 to empty the lower output receptacles 106c-106h and to make any spatial adjustments necessary to accommodate the British currency. A multitude of modes of operation are described in conjunction with bill flagging, presenting, and/or transport halting in commonly owned, co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Method and Apparatus for Document Processing" which was filed on May 28, 1997,  
30 incorporated herein by reference in its entirety above, which may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b.

In the illustrated embodiment, with regard to the upper output receptacles 106a, 106b, the second upper output receptacle 106b is provided with a stacker wheel 127 for accumulating a number of bills, while the first upper output receptacle 106a is not provided with such a stacker wheel. Thus, when pursuant to a preprogrammed mode of operation or an operator selected mode or other operator instructions, a bill is to be fed to the first upper output receptacle 106a, there may be a further instruction to momentarily suspend operation of the currency handling device 100 for the operator to inspect and remove the bill. On the other hand, it may be possible to allow a small number of bills to accumulate in the first upper output receptacle 106a prior to suspending operation. Similarly, the second upper output receptacle 106b may be utilized initially as an additional one of the lower output receptacles 106c-106h. However, there is no storage cassette associated with the second upper output receptacle 106b. Therefore, when the second upper output receptacle 106b is full, operation may be suspended to remove the bills at such time as yet further bills are directed to the second upper output receptacle 106b in accordance with the selected mode of operation or other operator instructions. In an alternative embodiment of the currency handling device 100 both the first and the second upper output receptacles 106a, 106b are equipped with a stacker wheel. In such an embodiment both the upper output receptacles 106a,b may also function as the lower output receptacle 106c-106h allowing a number of bills to be stacked therein.

FIGS. 2a and 2b illustrate the evaluation region 108 according to one embodiment of the currency handling system 100. The evaluation region can be opened for service, access to sensors, clear bill jams, *etc.* as shown in FIG. 2a. The characteristics of the evaluation region 108 may vary according to the particular application and needs of the user. The evaluation region 108 can accommodate a number and variety of different types of sensors depending on a number of variables. These variables are related to whether the machine is authenticating, counting, or discriminating denominations and what distinguishing characteristics are being examined, *e.g.* size, thickness, color, magnetism, reflectivity, absorbability, transmissivity, electrical conductivity, *etc.* The evaluation region 108 may employ a variety of detection means including, but not limited to, a size detection and density sensor 408, a lower 410 and an upper 412 optical scan head, a single or multitude of magnetic sensors 414, a thread sensor 416, and an ultraviolet/fluorescent light scan

head 418. These detection means and a host of others are disclosed in commonly owned, co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Multi-Pocket Currency Discriminator," incorporated by reference above.

5 The direction of bill travel through the evaluation region 108 is indicated by arrow A. The bills are positively driven along a transport plate 400 through the evaluation region 108 by means of a transport roll arrangement comprising both driven rollers 402 and passive rollers 404. The rollers 402 are driven by a motor (not shown) via a belt 401. Passive rollers 404 are mounted in such a manner as to be freewheeling about their respective axis and biased into counter-rotating contact with the  
10 corresponding driven rollers 402. The driven and passive rollers 402, 404 are mounted so that they are substantially coplanar with the transport plate 400. The transport roll arrangement also includes compressible rollers 406 to aid in maintaining the bills flat against the transport plate 400. Maintaining the bill flat against the transport plate 400 so that the bill lies flat when transported past the sensors enhances the overall  
15 reliability of the evaluation processes. A similar transport arrangement is disclosed in commonly-owned United States Patent No. 5,687,963 entitled "Method and Apparatus for Discriminating and Counting Documents," which is incorporated herein by reference in its entirety.

Referring now to FIGS. 3a-3d, the input receptacle 102 of the currency  
20 handling device 100 is illustrated. A feeder mechanism such as a pair of stripping wheels 140 aid in feeding the bills in seriatim to the transport mechanism 104 which first carries the bills through the evaluation region 108. According to one embodiment, the input receptacle 102 includes at least one spring-loaded feeder paddle 142a which is pivotally mounted, permitting it to be pivoted upward and drawn back to the rear of  
25 a stack of bills placed in the input receptacle 102 so as to bias the bills towards the evaluation region 108 via the pair of stripping wheels 140. The paddle 142a is coupled to an advance mechanism 144 to urge the paddle 142a towards the stripping wheels 140. In the illustrated embodiment, motion is imparted to the advance mechanism via a spring 145. In other alternative embodiments, the advance mechanism 144 is motor  
30 driven. The advance mechanism 144 is slidably mounted to a shaft 146. The advance mechanism 144 also constrains the paddle 142a to a linear path. The advance mechanism 144 may contain a liner bearing (not shown) allowing the paddle 142a to easily slide along the shaft 146. In the embodiment illustrated, the paddle 142a may

also contain channels 148 to aid in constraining the paddle 142a to a linear path along a pair of tracks 150. The paddle 142a may additionally include a roller 152 to facilitate the movement of the paddle 142a.

In the embodiment illustrated in FIGS. 3a-3d, a second paddle 142b is provided such that a second stack of bills 147 may be placed in the input receptacle 102 behind a first group of bills 149, while the first group of bills 149 is being fed into the currency handling device 100. Thus, the two feeder paddles 142a and 142b may be alternated during processing in order to permit multiple stacks of currency bills to be loaded into the input receptacle 102. In such an embodiment, the operator would retract paddle 142a and place a stack of bills into the input receptacle. Once inside the input receptacle, the operator would place the paddle 142a against the stack of bills so that the paddle 142a biases the stack of bills towards the pair of stripper wheels 140. The operator could then load a second stack of bills into the input receptacle 102 by retracting the second paddle 142b and placing a stack of bills in the input receptacle between the paddles 142a and 142b. The second paddle 142b urges the second stack of bills up against the backside of the first paddle 142a. The operator can then upwardly rotate the first paddle 142a thus combining the two stacks. The first paddle 142a is then retracted to the rear of the input receptacle and the process can be repeated. The two paddle input receptacle allows the operator to more easily continuously feed stacks of bills to the currency handling device 100. In devices not having two feeder paddles, the operator is forced to awkwardly manipulate the two stacks of bills and the advance mechanism. Alternatively, the operator may wait for the stack of bills to be processed out of the input receptacle to add another stack; however, waiting to reload until each stack is processed adds to the total time to process a given amount of currency.

Referring to FIG. 4, a portion of the transport mechanism 104 and diverters 130a-130d are illustrated. A substantial portion of the transport path of the currency handling device 100 positively grips the bills during transport from the pair of stripping wheels 140 through the point where bills are delivered to upper output receptacle 106a or are delivered to the stacker wheels 202 of output receptacles 106b-106h. The positive grip transport path of the currency handling device 100 is less costly and weighs less than the vacuum transport arrangements of prior currency processing devices.

The transport mechanism 104 is electronically geared causing all sections to move synchronously from the evaluation region 108 through the point where the bills are delivered to the output receptacles 106. Multiple small motors are used to drive the transport mechanism 104. Using multiple small, less costly motors is more efficient and less costly than a single large motor. Further, less space is consumed enabling the currency handling device 100 to be more compact. Electronically gearing the transport mechanism 104 enables a single encoder to monitor bill transportation within the currency handling system 100. The encoder is linked to the bill transport mechanism 104 and provides input to a processor to determine the timing of the operations of the currency handling device 100. In this manner, the processor is able to monitor the precise location of the bills as they are transported through the currency handling device 100. This process is termed "flow control." Input from additional sensors 119 located along the transport mechanism 104 of the currency handling device 100 enables the processor to continually update the position of a bill within the device 100 to accommodate for bill slippage. When a bill leaves the evaluation region 108 the processor expects the bill to arrive at the diverter 130a corresponding to the first lower output receptacle 106c after a precise number of encoder counts. Specifically, the processor expects the bill to flow past each sensor 119 positioned along the transport mechanism 104 at a precise number of encoder counts. If the bill slips during transport but passes a sensor 119 later within an acceptable number of encoder counts the processor updates or "re-queues" the new bill position. The processor calculates a new figure for the time the bill is expected to pass the next sensor 119 and arrive at the first diverter 130a. The processor activates the one of the diverters 130a-f to direct the bill into the appropriate corresponding lower output receptacle 106c-106h when the sensor 119 immediately preceding the diverter 130 detects the passage of the bill to be directed into the appropriate lower output receptacle 106c-h.

The currency handling device 100 also uses flow control to detect jams within the transport mechanism 104 of the device 100. When a bill does not reach a sensor 119 within in the calculated number of encoder counts plus the maximum number of counts allowable for slippage, the processor suspends operation of the device 100 and informs the operator via the display/user-interface 122 that a jam has occurred. The processor also notifies the operator via the display/user-interface 122 of the location of the jam by indicating the last sensor 119 that the bill passed and generally the

approximate location of the jam in the system. If the operator cannot easily remove the bill without damage, the operator can then electronically jog the transport path in the forward or reverse direction via the control unit 120 so that the jammed bill is dislodged and the operator can easily remove the bill from the transport path. The operator can then flush the system causing the transport mechanism 104 to deliver all of the bills currently within the transport path of the currency handling device 100 to one of the output receptacles 106. In an alternative embodiment, the user of the currency handling device 100 would have the option when flushing the system to first have the bills already within the escrow regions 116a-116f to be delivered to the respective lower storage cassettes 106c-106h so that those bills may be included in the aggregate value data for the bills being processed. The bills remaining in the transport path 104 would then be delivered to a predetermined escrow region 116 where those bills could be removed and reprocessed by placing those bills in the input receptacle 102.

Utilizing flow control to detect jams is more desirable than prior art currency evaluation machines which do not detect a jam until a sensor is actually physically blocked. The latter method of jam detection permits bills to pile up while waiting for a sensor to become blocked. Bill pile-up is problematic because it may physically halt the machine before the jam is detected and may cause physical damage to the bills and the machine. In order to remedy a jam in a prior art machine, the operator must first manually physically dislodge the jammed bills. The operator must then manually turn a hand crank which advances the transport path until all bills within the transport path are removed. Moreover, because the prior art devices permit multiple bills to pile up before a jam is detected, the integrity of the process is often ruined. In such a case, the entire stack of bills must be reprocessed.

Referring back to FIG. 1a, the illustrated embodiment of the currency handling device 100 includes a total of six lower output receptacles 106c-106h. More specifically, each of the lower output receptacles 106c-106h includes a first portion designated as an escrow compartment 116a-116f and a second portion designated as a storage cassette 118a-118f. Typically, bills are initially directed to the escrow compartments 116, and thereafter at specified times or upon the occurrence of specified events, which may be selected or programmed by an operator, bills are then fed to the storage cassettes 118. The storage cassettes are removable and replaceable,

such that stacks of bills totaling a predetermined number of bills or a predetermined monetary value may be accumulated in a given storage cassette 118, whereupon the cassette may be removed and replaced with an empty storage cassette. In the illustrated embodiment, the number of lower output receptacles 106c-106h including escrow compartments 116 and storage cassettes 118 are six in number. In alternative  
5 lower output receptacles including escrow compartments and storage cassettes 118. In other alternative embodiments, modular lower output receptacles 106 can be implemented to add many more lower output receptacles to the currency handling system 100. Each modular unit may comprise two lower output receptacles. In other  
10 alternative embodiments, several modular units may be added at one time to the currency handling device 100.

A series of diverters 130a-130f, which are a part of the transportation mechanism 104, direct the bills to one of the lower output receptacles 106c-106h.  
15 When the diverters 130 are in an upper position, the bills are directed to the adjacent lower output receptacle 106. When the diverters 130 are in a lower position, the bills proceed in the direction of the next diverter 130.

The vertical arrangement of the lower output receptacles 106c-106h is illustrated in FIG. 5. The escrow compartment 116 is positioned above the storage cassette 118. In addition to the escrow compartment 116 and the storage cassette 118,  
20 each of the lower output receptacles 106c-106h contains a plunger assembly 300. The plunger assembly 300 is shown during its decent towards the storage cassette 118.

Referring now to FIGS. 6 and 7, one of the escrow compartments 116 of the lower output receptacles 106c-106h is shown. The escrow compartment 116 contains  
25 a stacker wheel 202 to receive the bills 204 from the diverter 130. The stacker wheel 202 stacks the bills 204 within the escrow compartment walls 206, 208 on top of a gate 210 disposed between the escrow compartment 116 and the storage cassette 118. In an alternative embodiment, the escrow compartment 116 contains a pair of guides to aid in aligning the bills substantially directly on top of one another. The gate 210 is  
30 made up of two shutters: a first shutter 211 and a second shutter 212. The shutters 211, 212 are hingedly connected enabling the shutters 211, 212 to rotate downward approximately ninety degrees to move the gate from a first position (closed position) wherein the shutters 211, 212 are substantially co-planer to a second position (open



position) wherein the shutters 211, 212 are substantially parallel. Below the gate 210 is the storage cassette 118 (not shown in FIGS. 6 and 7).

FIG. 8 illustrates the positioning of the paddle 302 when transferring a stack of bills from the escrow compartment 116 to the storage cassette 118. When the paddle descends upon the stack of bills 204 it causes shutters 211, 212 to quickly rotate in the directions referred to by arrows B and C, respectively; thus, "snapping" open the gate 210. The quick rotation of the shutters 211, 212 insures that the bills fall into the storage cassette 118 in a substantially stacked position. According to one embodiment, the paddle is programmed to descend after a predetermined number of bills 204 are stacked upon the gate 210. According to other embodiments, the operator can instruct the paddle 302 via the control unit 120 to descend upon the bills 204 stacked upon the gate 210.

Referring now to FIG. 9, the plunger assembly 300 for selectively transferring the bills 204 from an escrow compartment 116 to a corresponding storage cassette 118 and the gate 210 are illustrated in more detail. One such plunger assembly 300 is provided for each of the six lower output receptacles 106c-106h of the currency handling device 100. The plunger assembly 300 comprises a paddle 302, a base 304, and two side arms 306, 308. Each of the shutters 211, 212 comprising the gate 210 extend inwardly from corresponding parallel bars 214, 215. The bars 214, 215 are mounted for pivoting the shutters between the closed position and the open position. Levers 216, 217 are coupled to the parallel bars 214, 215, respectively, to control the rotation of the bars 214, 215 and hence of the shutters 211, 212. Extension springs 218, 219 (shown in FIG. 8) tend to maintain the position of the levers 216, 217 both in the closed and open positions. The shutters 211, 212 have an integral tongue 213a and groove 213b arrangement which prevents any bills which are stacked upon the gate 210 from slipping between the shutters 211, 212.

The base 304 travels along a vertical shaft 311 with which it is slidably engaged. The base 304 may include linear bearings (not shown) to facilitate its movement along the vertical shaft 311. The plunger assembly 300 may also include a vertical guiding member 312 (see FIG. 11) with which the base 304 is also slidably engaged. The vertical guiding member 312 maintains the alignment of the plunger assembly 300 by preventing the plunger assembly 300 from twisting laterally about the

vertical shaft 311 when the paddle 302 forces the bills 204 stacked in the escrow area 116 down into a storage cassette 118.

Referring also to FIG. 10, the paddle 302 extends laterally from the base 304. The paddle 302 is secured to a support 314 extending from the base 304. A pair of side arms 306, 308 are hingedly connected to the base. Each of the side arms 306, 308 protrude from the sides of the base 304. Rollers 316, 318 are attached to the side arms 306, 308, respectively, and are free rolling. Springs 313a, 313b are attached to the side arms 306, 308, respectively, to bias the side arms 306, 308 outward from the base 304. In the illustrated embodiment, the spring 313a, 313b are compression springs.

The paddle 302 contains a first pair of slots 324 to allow the paddle to clear the stacker wheel 202 when descending into and ascending out of the cassette 118. The first pair of slots 324 also enables the paddle 302 to clear the first pair of retaining tabs 350 within the storage cassette (see FIG. 14). Similarly, paddle 302 contains a second pair of slots 326 to enable the paddle 302 to clear the second pair of retaining tabs 350 within the storage cassette 118 (see FIG. 14).

Referring now to FIG. 11, which illustrates a rear view of one of the lower output receptacles 106c-106h, the plunger 300 is bidirectionally driven by way of a belt 328 coupled to an electric motor 330. A clamp 332 engages the belt 328 into a channel 334 in the base 304 of the plunger assembly 300. In the embodiment illustrated in FIG. 11, two plunger assemblies 300 are driven by a single electric motor 330. In one embodiment of the currency handling device, the belt 328 is a timing belt. In other alternative embodiments, each plunger assembly 300 can be driven by a single electric motor 330. In still other alternative embodiments, there can be any combination of motors 330 to plunger assemblies 300.

FIGS. 12 and 13 illustrate the interaction between the side arms 306, 308 and the levers 216, 217 when the paddle assembly 300 is descending towards and ascending away from the storage cassette 118, respectively. Initially, before descending towards the cassette, the shutters are in a first (closed) position. In the illustrated embodiment, it is the force imparted by the paddle 302 which opens the gate 210 when the paddle descends towards the storage cassette 118. When the paddle is ascending away from the storage cassette 119, it is the rollers 316, 318 coupled to the side arms 306, 308 which engage the levers 216, 217 that close the gate 210. The levers 216, 217 shown in FIG. 12 are positioned in the open position. When

descending towards the storage cassette 118, the rollers 316, 318 contact the levers 216, 217 and roll around the levers 216, 217 leaving the shutters in the open position. The side arms 306, 308 are hinged in a manner which allows the side arms 306, 308 to rotate inward towards the base 304 as the rollers 316, 318 engage the levers 216, 217. FIG. 13 illustrates the levers in the second position wherein the gate 210 is closed. When the paddle ascends out of the storage cassette, the side arms 306, 308 are biased away from the base 304. The rollers 316, 318 engage the levers 216, 217 causing the levers to rotate upward to the first position thus closing the gate.

FIGS. 14, 15, and 16 illustrate the components of the storage cassettes 118. The bills 204 are stored within the cassette housing 348 which has a base 349. Each storage cassette 118 contains two pairs of retaining tabs 350 positioned adjacent to the interior walls 351, 352 of the storage cassette. The lower surface 354 of each tab 350 is substantially planar. The tabs 350 are hingedly connected to the storage cassette 118 enabling the tabs 350 to downwardly rotate from a horizontal position, substantially perpendicular with the side interior walls 351, 352 of the cassette 118, to a vertical position, substantially parallel to the interior walls 351, 352 of the cassette 118. The tabs 350 are coupled to springs (not shown) to maintain the tabs in the horizontal position.

The storage cassette 118 contains a slidable platform 356 which is biased upward. During operation of the currency handling system 100, the platform 356 receives stacks of bills from the escrow compartment 116. The floor 356 is attached to a base 358 which is slidably mounted to a vertical support member 360. The base 358 is spring-loaded so that it is biased upward and in turn biases the platform 356 upward. The storage cassettes 118 are designed to be interchangeable so that once full, a storage cassette can be easily removed from the currency handling device 100 and replaced with an empty storage cassette 118. In the illustrated embodiment, the storage cassette 118 is equipped with a handle 357 in order to expedite removal and/or replacement of the storage cassettes 118. Also in the illustrated embodiment, the storage cassette 118 has a door 359 which enables an operator to remove bills from the storage cassette 118.

The storage cassettes 118 are dimensioned to accommodate documents of varying sizes. In the illustrated embodiment, the storage cassettes 118 has a height,  $H_2$ , of approximately 15.38 inches (39 cm), a depth,  $D_2$ , of approximately 9 inches

(22.9 cm), and a width,  $W_2$ , of approximately 5.66 inches (14.4 cm). The storage cassette illustrated in FIG. 15 has stand-offs 362 to set interior wall 352 off a fixed distance from in the interior wall 353 of the cassette housing 348. The interior walls 351, 352 aid in aligning the bills in a stack within the storage cassettes. The  
5 embodiment of the storage cassette illustrate in FIG. 15 is sized to accommodate United States currency documents. To properly accommodate United States currency documents, the interior width of the storage cassette,  $W_3$ , is approximately 2.88 inches. FIGS. 17a and 17b also illustrate an embodiment of the storage cassette 118 sized to accommodate U.S. currency documents which have a width of approximately 2.5  
10 inches (approximately 6.5 cm) and a length of approximately 6 inches (approximately 15.5 cm). In alternative embodiments, the length of the stand-offs 362 can be varied to accommodate documents of varying sizes. For example, the embodiment disclosed in FIG. 18a and 18b has an interior width,  $W_3$  of approximately 4.12 inches (104.6 cm) and is sized to accommodate the largest international currency, the French 500 Franc  
15 note, which has width of approximately 3.82 inches (9.7 cm) and a length of approximately 7.17 inches (18.2 cm). In order to accommodate large documents and increase the interior width,  $W_3$ , of the storage cassette 118, the lengths of stand-offs 362, illustrated in FIG. 16b, are shortened.

Beginning with FIG. 7, the operation of one of the lower output receptacles  
20 106c-106h will be described. Pursuant to a mode of operation, the bills 204 are directed by one of the diverters 130 into the escrow compartment 116 of the lower output receptacle. The stacker wheel 202 within escrow compartment 116 receives the bills 204 from the diverter 130. The stacker wheel 202 stacks the bills 204 on top of the gate 210. Pursuant to a preprogrammed mode of operation, once a  
25 predetermined number of bills 204 are stacked in the escrow compartment 116, the control unit 120 instructs the currency handling device 100 to suspend processing currency bills and the paddle 302 then descends from its home position above the escrow compartment 116 to transfer the bills 204 into the storage cassette 118. Once the bills 204 have been deposited in the storage cassette 118 the currency handling  
30 device resumes operation until an escrow compartment is full or all the bills within the input receptacle 102 have been processed.

Referring now to FIGS. 8 and 9 the plunger assembly 300 downwardly travels placing the paddle 302 onto of the stack of bills 204. Upon making contact with the

bills 204 the paddle 302 continues to travel downward. As the paddle 302 continues its descent, the paddle 302 forces the gate 210 to snap open. The paddle 302 imparts a force to the bills 204 that is transferred to the to the shutters 211, 212 causing the shutters 211, 212 to rotate from the closed position to the open position. The rotation of the shutters 211, 212 is indicated by the arrows B and C, respectively. Once the paddle 302 imparts the amount of force necessary to rotate levers 216, 217, the extension springs 218, 219 quickly rotate the shutters 211, 212 downward, thus “snapping” the gate 210 open. The downward rotation of the shutters 211, 212 causes each of the corresponding parallel bars 214, 215 to pivot which in turn rotates the levers 216, 217. The extension springs 218, 219 maintain the shutters 211, 212 in the open position allowing the paddle 302 to descend into the storage cassette 118. The hingedly connected side arms 306, 308 retract as the rollers 316, 318 to roll around the levers 216, 217 while the plunger assembly 300 is traveling downward into the cassette 118.

Referring now to FIG. 15, once the gate 210 is opened, the bills 204 fall a short distance onto the platform 356 of the storage cassette 118 or onto a stack of bills 204 already deposited on the platform 356. The paddle 302 continues its downward motion towards the storage cassette 118 to ensure that the bills 204 are transferred to the cassette 118. Initially, some bills 204 may be spaced apart from the platform 356 or the other bills 204 within the storage cassette by retaining tabs 350. As the plunger assembly 300 continues to descend downward into the cassette, the paddle 302 continues to urge the stack of bills 204 downward causing the retaining tabs 350 to rotate downward. The bills 204 are pushed past retaining tabs 350 and onto the platform 356.

Once the plunger assembly 300 has descended into the cassette 118 a distance sufficient for the paddle 302 to clear the retaining tabs 350 allowing the retaining tabs 350 to rotate upward, the plunger assembly initiates its ascent out of the storage cassette 118. The platform 356 urges the bills 204 upward against the underside of the paddle 302. The paddle 302 is equipped with two pairs of slots 324, 326 (FIG. 9) to enable the paddle to clear the pairs of retaining tabs 350. When the paddle 302 ascends past the pairs of retaining tabs 350 the bills 204 are pressed against the lower surfaces 354 of the pairs of retaining tabs 350 by the platform 356.

Referring now to FIG. 13, when the plunger assembly 300 is traveling upward out of the cassette 118, the rollers 316, 318 on the side arms 306, 308 engage the respective levers 216, 217 and move the respective levers 216, 217 from the second (open) position to the first (closed) position to move the gate 210 from the open position to the closed position as the paddle 302 ascends into the escrow compartment 116 after depositing the bills 204 in the storage cassette 118. The paddle 302 is mounted on the base 304 above the rollers 316, 318 on the side arms 306, 308 so that the paddle 302 clears the gate 210 before the gate 210 is moved to the closed position.

In alternative embodiments of the currency handling device 100, the output receptacles 106 can be sized to accommodate documents of varying sizes such as various international currencies, stock certificates, postage stamps, store coupons, *etc.* Specifically, to accommodate documents of different widths, the width of the escrow compartment 116, the gate 210, and the storage cassette 118 would need to be increased or decreased as appropriate. The document evaluation device 100 is sized to accommodate storage cassettes 118 and gates 210 of different widths. The entire transport mechanism 104 of the currency handling device 100 is dimensioned to accommodate the largest currency bills internationally. Accordingly, the document handling device 100 can be used to process the currency or documents of varying sizes.

In various alternative embodiments, the currency handling device 100 is dimensioned to process a stack of different sized currencies at the same time. For example, one application may require the processing of United States dollars (2.5 inches x 6 inches, 6.5 cm x 15.5 cm) and French currency (as large as 7.17 inches x 3.82 inches, 18.2 cm x 9.7 cm). The application may simply require the segregation of the U.S. currency from the French currency wherein the currency handling device 100 delivers U.S. currency to the first lower output receptacle 106c and the French currency to the second output receptacle 106d. In another alternative embodiment, the currency handling device 100 processes a mixed stack of U.S. ten and twenty dollar bills and French one hundred and two hundred Franc notes wherein the currency documents are denominated, counted, and authenticated. In that alternative embodiment, the U.S. ten and twenty dollar bills are delivered to the first 106c and second 106d lower output receptacles, respectively, and the French one hundred and two hundred Franc notes are delivered to the third 106e and fourth 106f lower output

receptacle, respectively. In other alternative embodiments, the currency handling device 100 denominates, counts, and authenticates six different types of currency wherein, for example, Canadian currency is delivered to the first lower output receptacle 106c, United States currency is delivered to the second output receptacle 106d, Japanese currency is delivered to the third lower output receptacle 106e, British currency is delivered to the fourth lower output receptacle 106f, French currency is delivered to the fifth lower output receptacle 106g, and German currency is delivered to the sixth lower output receptacle 106h. In another embodiment, no call bills or other denominations of currency, such as Mexican currency for example, may be directed to the second upper output receptacle 106b. In another embodiment, suspect bills are delivered to the first upper output receptacle 106a.

In other alternative embodiments of the currency handling device 100, the user can vary the type of documents delivered to the output receptacles 106. For example, in one alternative embodiment an operator can direct, via the control unit 120, that a stack of one, five, ten, twenty, fifty, and one-hundred United States dollar bills be denominated, counted, authenticated, and directed into lower output receptacles 106c-106h, respectively. In still another alternative embodiment, the currency handling device 100 is also instructed to deliver other bills, such as a United States two dollar bill or currency documents from other countries that have been mixed into the stack of bills, to the second upper output receptacle 106b. In still another alternative embodiment, the currency handling device 100 is also instructed to count the number and aggregate value of all the currency bills processed and the number and aggregate value of each individual denomination of currency bills processed. These values can be communicated to the user via the display/user-interface 122 of the currency handling device 100. In still another alternative embodiment, no call bills and bills that are stacked upon one another are directed to the second upper output receptacle 106b. In still another alternative embodiment, the operator can direct that all documents failing an authentication test be delivered to the first upper output receptacle 106a. In another alternative embodiment, the operator instructs the currency handling device 100 to deliver no call bills, suspect bills, stacked bills, *etc.* to one of the lower output receptacles 106c-106h. The currency handling device 100 which has eight output receptacles 106a-106h provides a great deal of flexibility to the user. And in other

alternative embodiments of the currency handling device 100, numerous different combinations for processing documents are available.

According to one embodiment, the various operations of the currency handling device 100 are controlled by processors disposed on a number of printed circuit boards ("PCBs") such as ten PCBs located throughout the device 100. In one embodiment of the present invention, the processors are Motorola processors, model number 86HC16, manufactured by Motorola, Inc. of Schaumburg, Illinois. Each of the processors are linked to a central controller via a general purpose communications controller disposed on each PCB. In one embodiment of the present invention the communications controller is an ARCNET communications controller, model COM20020, manufactured by Standard Microsystems Corporation of Hauppauge, New York. The communications controller enables the central controller to quickly and efficiently communicate with the various components linked to the PCBs.

According to one embodiment, two PCBs, a "motor board" and a "sensor board," are associated with each pair of lower output receptacles 106c-106h. The first two lower output receptacles 106c,d, the second two lower output receptacles 106e,f, and the last two lower output receptacles 106g,h are paired together. Each of the lower output receptacles 106 contain sensors which track the movement of the bills into the lower output receptacles 106c-106h, detect whether each storage cassette 118a-118e is positioned within the currency handling device 100, detect whether the doors 359 of the storage cassettes 118 are opened or closed, and whether the cassettes 118 are full. These aforementioned sensors associated with each pair of the lower output receptacles are tied into a sensor board which is linked to the central controller. The operation of the plunger assembly 300, the stacker wheels 202, the portion of transportation mechanism 104 disposed above the lower output receptacles 116c-116h, and the diverters 130 are controlled by processors disposed on the motor board associated with each pair of lower output receptacle's 106c-106h. Those sensors 130 which track the movement of bills along the transportation mechanism 104 that are disposed directly above the lower output receptacles 106c-106h are also tied into the respective motor boards.

One of the four remaining PCBs is associated with the operation of the one or two stacker wheels 127 associated with the upper output receptacles 106a,b, the stripping wheels 140, the primary drive motor of the evaluation region 108, a diverter



which direct bills to the two upper output receptacles 106a,b, and the diverter which then directs bills between the two upper output receptacles 106a,b. The remaining three PCBs are associated with the operation of the transport mechanism 104 and a diverter which directs bills from the transport path to the bill facing mechanism 110. The plurality of sensors 130 disposed along the transport mechanism 104, used to track the movement of bills along the transport mechanism 104, also tied into these three remaining PCBs.

During the lifetime of prior art currency handling devices it is likely that individual key components of the devices, including components specific to the output receptacles, will degrade and eventually fail. The failure of an individual component specific to an output receptacle can render that output receptacle inoperable. The inoperability of one of the output receptacles of prior art currency handling devices can render the entire device inoperable regardless of whether the remaining output receptacles are otherwise properly functioning. Component failures resulting in the inoperability of the entire device can have a devastating effect on the cash handling operations of users of these devices. The inventors of the present invention have found that currency handling devices play a vital role in the overall operation of a cash vault, including cash vaults at banks or casinos. The inventors estimate that over 90% (ninety percent) of the cash handled within a cash vault is processed by a currency handling device. Therefore, the failure of a currency handling device can have a disastrous effect on the operation of a cash vault or other operations relying on the performance of the currency handling device.

Like prior art currency handling devices, it is anticipated that over the extended lifetime of the currency handling device 100 components of the device 100, including components specific to the output receptacles 106, will degrade and eventually fail. Such individual components include, for example, the motor 330 (FIG. 11), the belt 328 (FIG. 11), sensors such as the bill passage sensors 119, solenoids, switches that indicate a cassette 118 is properly inserted into an output receptacle 106, and other electrical or mechanical components of the output receptacles 106. However, the currency processing device 100 of the present invention implements a backup routine to remedy the failure of a component(s) of an output receptacle 106 which would otherwise render the currency handling device 100 inoperable. The inventors of the present invention use the term "disable pockets" to describe this backup routine which

essentially disables one or more output receptacles 106 (also called a “pocket”) in which component failure(s) have occurred.

Upon the failure of a component within one of the output receptacles, the user of the currency handling device 100 is informed of the error via the user interface 112. For example, each of the lower output receptacles 106c-h contains a switch (not shown) that is tripped when a cassette 118 is properly inserted into the output receptacle 106. Under normal circumstances, the control unit 120 detects the tripped switch upon proper insertion of a cassette 118 into the output receptacle 106 and the currency handling device 100 operates as intended. When a cassette 118 is improperly inserted, the control unit 120 does not detect the presence of a properly inserted cassette 118 and the user is prompted via the user interface 122. Upon a visual inspection or physical manipulation of the storage cassette 118, the operator can quickly determine whether the cassette 118 is properly inserted within the output receptacle 106. If the operator determines the cassette 118 is properly inserted and the error signal indicating otherwise is itself an error, the operator can implement the disable pockets routine via the user interface 122.

The implementation of the disable pockets routine will cause the control unit 120 to ignore the error conditions associated with the output receptacle 106 experiencing component failure by essentially shutting down that output receptacle, allowing the currency handling device 100 to operate with one less lower output receptacle 106c-h. For example, disabling the first lower output receptacle 106c will cause the currency handling device 100 to operate as though the device 100 has five lower output receptacles – the second lower output receptacle 106d through the sixth lower output receptacle 106h. Those bills normally directed to the first lower output receptacle 106c are now, pursuant to the disable pockets routine, directed to another one of the output receptacles 106 such as the first or second upper output receptacles 106a-b. In other embodiments of the device 100, more than one lower output receptacle 106c-h may be disabled. For example, disabling the first two lower output receptacles 106c-d will cause the currency handling device 100 to operate with four lower output receptacles – the third lower output receptacle 106e through the sixth lower output receptacle 106h.

According to one embodiment of the disable pockets routine, those bills which would normally be directed to the inoperable output receptacle(s) are now directed to

the output receptacle to which bills triggering error conditions (*e.g.*, no call bills) are directed pursuant to various modes of operation. The disable pockets routine is designed to work with existing modes of operation (or other user-defined modes of operation) such as, for example, those modes of operation incorporated by reference above from U.S. Patent Application Serial No. 08/916,100 as well as disclosed in International Patent Application Publication No. WO 99/09511, both of which are incorporated herein by reference in their entireties. Put another way, the disable pockets routine compliments the user-selected mode of operation by directing bills otherwise directed to the disabled output receptacle to an alternative output receptacle.

In one embodiment of the disable pockets routine directs the bills otherwise directed to the disabled output receptacle to an output receptacle 106 to which bills triggering error conditions are directed pursuant to the current mode of operation of the currency handling device 100. By way of example, one mode of operation may direct bills triggering a "no call" error condition to the second lower output receptacle 106b while directing U.S. \$1 bills to the first lower output receptacle 106c. Upon disabling the first lower output receptacle 106c, \$1 bills are automatically directed to the no call output receptacle 106b which is the second lower output receptacle. During operation of the device 100, both no call bills and identifiable \$1 bills are directed to the second lower output receptacle 106b. The device 100 can suspend operation when a no call bill is delivered into the second upper output receptacle 106b giving the operator the opportunity to remove the no call bills from the identifiable \$1 bills. Alternatively, all bills triggering error conditions may be directed to the first upper output receptacle 106a and \$1 bills are directed to the second lower output receptacle 106b. In other alternative embodiments, after one or more of the output receptacles 106 is disable, the user is prompted to select which of the remaining output receptacles 106 are to replace the disabled output receptacle 106. The user may designate that U.S. \$1 bills be directed to the sixth lower output receptacle along with U.S. \$5 bills for example. Many of the modes of operation direct no call bills to one of the upper output receptacles 106a,b. However, in alternative embodiments of the present invention, bills triggering error conditions can be directed into any one of the plurality of output receptacles 106.

Referring now to FIG. 19, the operation of the currency handling device 100 pursuant to one embodiment of the disable pockets routine 400 will be described.

Before implementing the disable pockets routine, the user of the currency handling device 100 determines that it is necessary to disable of one or more of the output receptacles 106 of the device 100. Upon deciding to process a batch of currency bills, the user inputs or selects (via the user interface 122) a mode of operation at step 402.

5 An illustrative screen 450 which may be displayed on the user interface 122 is illustrated in FIG. 21. The user can select one of a plurality of buttons 452 corresponding to the desired mode of operation. This step 402 may also include assigning denominations and strap limits to a specific mode of operation by selecting buttons 472 as shown in the illustrative screen 470 of FIG. 22. The currency handling

10 device 100 is able to process bills according to a strapping mode of operation as described in co-pending U.S. Patent Application Serial No. 09/635,181 entitled "Method of Creating Identifiable Smaller Stacks of Currency Bills within a Larger Stack of Currency Bills," which was filed on August 8, 2000 and is incorporated herein by reference in its entirety. At step 404, the user instructs the device 100 to disable

15 one of the output receptacles 106. This may include designating the specific output receptacle(s) 106 to be enabled and which output receptacle(s) 106 to be disabled. An illustrative screen 460 which may be displayed on the user interface 122 is illustrated in FIG. 23. According to the illustrative screen 460 of FIG. 22, buttons 461-464 have been selected thus enabling the first four lower output receptacles 106c-f while buttons

20 465-466 have not been selected thus disabling the fifth and sixth lower output receptacles 106g-h. Alternatively, the disable pockets routine automatically disables the inoperable output receptacle(s) 106. Thereafter, the operation of the currency handling device 100 commences. As each bill is transported through the evaluation region 108, information concerning each bill is determined at step 406. Such

25 information can include denomination, currency type, or authenticity. Next, based on the determined information concerning the bill, an output receptacle 106 to which the device 100 normally transports that bill is designated at step 408. The designated output receptacle 106 is determined pursuant to the particular mode of operation. For example, a particular mode of operation may designate the first lower output

30 receptacle 106c for U.S. \$1 bills and the second lower output receptacle 106d for \$1 Canadian bills. The designated output receptacle (designated pursuant to the mode of operation) is checked against the disabled output receptacle (disable pursuant to the disable pockets routine) at step 408. If the designated output receptacle 106 is not the

disabled output receptacle, the bill is directed to the designated output receptacle 106 at step 412. If the designated output receptacle is the disabled output receptacle, the bill is directed to the output receptacle designated for no call bills – typically, one of the two upper output receptacles 106a,b is designated for no calls.

5           Referring now to FIG. 20, the operation of the currency handling device pursuant to another embodiment of the disable pockets routine 420 will be described. Again, before implementing the disable pockets routine 420, the user of the currency handling device 100 determines that it is necessary to disable one or more of the output receptacles 106 of the device 100. Upon deciding to process a batch of  
10       currency bills, the user inputs or selects (via the user interface 122) a mode of operation at step 422. At step 424, the user instructs the device 100 to disable one or more of the output receptacles 106. According to alternative embodiments, steps 422 and 424, or steps 402 and 404 with regard to FIG. 19, can be performed in the reverse order. Again, step 424 may include designating the specific output receptacle(s) to be  
15       disabled. Alternatively, the disable pockets routine 420 at step 424 automatically disables the inoperable output receptacle(s). At step 426, the output receptacle designations pursuant to the selected mode of operation (*e.g.*, U.S. \$10 bills are directed to the third lower output receptacle 106e) are updated to reflect the disabling of the output receptacle(s). For example, pursuant to one mode of operation, the third  
20       lower output receptacle 106e is designated to receive U.S. \$10 bills and the second upper output receptacle 106b may be designated to receive no call bills. At step 426, the designation of the second upper output receptacle 106b is updated to include U.S. \$10 bills. In one embodiment of the disable pockets routine 420, the disabled output receptacles are replaced with those output receptacles 106 assigned to bills triggering  
25       error conditions (*e.g.*, no calls) are directed such as either of the two upper output receptacles 106a-b. Alternatively, step 426 may include selecting the particular output receptacle(s) 106 to replace the disabled output receptacles. Thereafter, the operation of the output receptacles is commenced. At step 428, information concerning each of the bills is determined such bill denomination. The determined information is used to  
30       designate to which output receptacle a particular bill will be directed at step 432. For example, bills determined to be U.S. \$100 bills are directed to lower output receptacles 106h. And at step 432, the device 100 directs the bill to the designated output receptacle 106.

Pursuant to one mode of operation, an operator can direct, via the control unit 120 at step 402, that a batch of bills be processed such that stacks of U.S. \$1, \$5, \$10, \$20, \$50, and \$100-bills are denominated, counted, authenticated, and directed into lower output receptacles 106c-106h, respectively. Other bills such as U.S. \$2 bills, currency bills from other countries that have been mixed into the batch of bills, and non-identifiable bills (*e.g.*, no calls) are directed to the second upper output receptacle 106b. Lastly those U.S. \$1, \$5, \$10, \$20, \$50, and \$100 bills determined to be non-authentic (*e.g.*, suspect documents) are directed to the first upper output receptacle 106a. The above-described mode of operation is simply one example of the manner in which the currency handling machine 100 processes currency bills. The currency handling device 100 having eight output receptacles 106a-106h provides a great deal of flexibility to the user. And in other alternative embodiments of the currency handling device 100, numerous different combinations for processing documents are available. Upon a user implementing the disable pockets routine, an output pocket – the first lower output receptacle 106c, for example – is disabled. Accordingly, during the processing of each of the bills in the batch are processed as described above except that U.S. \$1 bills are directed into the second upper output receptacle 106b along with those bill determined to be strangers.

As indicated above, in alternative embodiments of the disable pockets routine, the user can designate the output receptacle to which the bills normally directed to one or more disabled pocket are to be directed. In such an embodiment, upon selection of the disable pockets routine, the device 100 may prompt the user via the user interface 122 to specify the alternative output receptacle(s) 106 to which to direct bills otherwise directed to the disabled output receptacle(s) 106. For example, using the above-described scenario, both U.S. \$1 and \$5 bills may be directed to the second lower output receptacle 106d when the first lower output receptacle 106c is disabled. Such an embodiment may be advantageous if the user anticipates a low volume of U.S. \$1 and \$5 bills. The user can vary the output receptacle(s) 106 to which bills otherwise directed to disabled output receptacles are directed in a manner best suited to the particular application.

The disable pockets routine provides a temporary solution to remedy of the inoperability of one of the output receptacles. The users of the currency handling

device 100 can continue to process currency bills while awaiting the arrival of spare parts and/or waiting for repairs to take place.

5 While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and herein described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

**CLAIMS:**

1. A currency handling device for rapidly processing a plurality of currency bills, the device comprising:
  - an input receptacle adapted to receive the currency bills to be processed;
  - 5 a plurality of output receptacles adapted to receive the bills after the bills have been evaluated;
  - a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the plurality of output receptacles;
  - an evaluating unit adapted to determine information concerning the bills, the evaluating
  - 10 unit including at least one sensor positioned along the transport path; and
  - a controller adapted to operate the currency handling device according to a mode of operation wherein the mode of operation designates the output receptacle to which each of the bills are to be transported based on determined information concerning the bill, the controller being adapted to disable at least one of the plurality of output receptacles, the controller being
  - 15 adapted to cause the transport mechanism to redirect bills directed to the disabled one of the plurality of output receptacles pursuant to the mode of operation to an alternative output receptacle.
2. The currency handling device of claim 1 wherein the controller is adapted to
- 20 detect the presence of an error condition in at least one of the plurality of output receptacles.
3. The currency handling device of claim 2 wherein the controller is adapted to disable an output receptacle having an error condition detected therein.
- 25 4. The currency handling device of claim 3 further comprising a user interface adapted to receive input from a user of the currency handling device, the controller being adapted to disable an output receptacle having an error condition detected therein in response to user input.
- 30 5. The currency handling device of claim 4 further comprising a user interface adapted to receive input from a user of the currency handling device specifying the mode of operation from a plurality of modes of operation.



6. The currency handling device of claim 1 comprising a user interface adapted to receive input from a user specifying the output receptacles to be disabled.

5 7. The currency handling device of claim 6 further wherein the user interface is adapted to receive input from a user specifying which of the plurality of output receptacles is the alternative output receptacle.

8. The currency handling device of claim 1 wherein the alternative output  
10 receptacle is the output receptacle to which no call bills are transported pursuant to the mode of operation.

9. A method of processing a plurality of currency bills with a currency  
handling device, the method comprising:  
15 disabling at least one of a plurality of output receptacles;  
receiving a plurality of currency bills in an input receptacle;  
transporting the bills with a transport mechanism, one at a time, from the input  
receptacle past an evaluating area to the plurality of output receptacles;  
determining information concerning each of the bills with an evaluating unit;  
20 designating the particular one of the plurality of output receptacles to which each of  
the bills are transported based on the determined information concerning each of the bills;  
comparing the designated output receptacle for each of the bills to the disabled output  
receptacle; and  
re-designating the particular one of the plurality of output receptacles to which each of  
25 the bills are transported to an alternative output receptacle when the designated output  
receptacle is the disabled output receptacle.

10. The method of claim 9 further comprising detecting the presence of an error  
condition within the plurality of output receptacles.

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11. The method of claim 10 wherein disabling further comprises disabling the  
output receptacle having an error condition detected therein.

12. The method of claim 11 wherein the currency handling device includes a user interface, and wherein disabling further comprises disabling the output receptacle having an error condition detected therein in response to user input.

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13. The method of claim 9 further comprising receiving input from a user of the currency handling device selecting a mode of operation from a plurality of modes of operation stored within a memory of the currency handling device, wherein the mode of operation designates the one of the plurality of output receptacles to which each of the bills are transported based on the determined information concerning the bill.

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14. The currency handling device of claim 13 wherein the alternative output receptacle is the output receptacle to which no call bills are transported pursuant to the specified mode of operation.

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15. The method of claim 9 further comprising receiving input from a user of the currency handling device specifying the particular one of the plurality of output receptacles to be disabled.

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16. The method of claim 9 further comprising receiving input from a user of the currency handling device specifying which of the plurality of output receptacles is the alternative output receptacle.

17. A method of processing a plurality of currency bills with a currency handling device, the currency handling device including a transport mechanism adapted to transport each of the bills, one at a time, from an input receptacle past an evaluation unit to a plurality of output receptacles, the currency handling device includes a user-interface adapted receive input from a user of the currency handling device, the method comprising:

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disabling at least one of a plurality of output receptacles;  
receiving a plurality of currency bills;

transporting the bills from the input receptacle past the evaluating unit to the plurality of output receptacles;  
determining information concerning each of the bills;  
designating the particular one of the plurality of output receptacles to which each of  
5 the bills are transported based on the determined information concerning each of the bills;  
comparing the designated output receptacle for each of the bills to the disabled output receptacle; and  
re-designating the particular one of the plurality of output receptacles to which each of  
the bills are transported to an alternative output receptacle when the designated output  
10 receptacle is the disabled output receptacle.

18. The method of claim 17 further comprising detecting the presence of an error condition within the plurality of output receptacles.

15 19. The method of claim 18 wherein disabling further comprises disabling the output receptacle having an error condition detected therein.

20 20. The method of claim 19 further comprising disabling the output receptacle having an error condition detected there in response to user input.

21. The method of claim 17 further comprising receiving input from a user of the currency handling device selecting a mode of operation from a plurality of modes of operation stored within a memory of the currency handling device, wherein the mode of operation designates to the output receptacle to which each of the bills are transported based on the  
25 determined information concerning the bill.

22. The currency handling device of claim 21 wherein the alternative output receptacle is the output receptacle to which no call bills are transported pursuant to the selected mode of operation.

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23. The method of claim 17 further comprising receiving input from a user of the currency handling device specifying the particular one of the plurality of output receptacles to be disabled.

5           24. The method of claim 17 further comprising receiving input from a user of the currency processing device specifying which of the plurality of output receptacles is the alternative output receptacle.

25. A method of processing a plurality of currency bills with a currency  
10 handling device, the currency handling device including a transport mechanism adapted to transport each of the bills, one at a time, from an input receptacle past an evaluation unit to a plurality of output receptacles, the currency handling device includes a user-interface adapted receive input from a user of the currency handling device, the method comprising:

15           disabling at least one of a plurality of output receptacles;  
            updating at least one output receptacle designation of a mode of operation to direct those bills designated to be delivered to the at least one disabled output receptacle to an alternative output receptacle;  
            receiving a plurality of currency bills;  
20           transporting the bills from the input receptacle past the evaluating unit to the plurality of output receptacles;  
            determining information concerning each of the bills; and  
            designating the particular one of the plurality of output receptacles to which each of the bills are transported based on the determined information concerning each of the bills;

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26. The method of claim 25 further comprising detecting the presence of an error condition within the plurality of output receptacles.

27. The method of claim 26 wherein disabling further comprises disabling the  
30 output receptacle having an error condition detected therein.

28. The method of claim 27 further comprising disabling the output receptacle having an error condition detected there in response to user input.

29. The method of claim 25 further comprising receiving input from a user of the  
5 currency handling device selecting a mode of operation from a plurality of modes of operation stored within a memory of the currency handling device, wherein the mode of operation designates to the output receptacle to which each of the bills are transported based on the determined information concerning the bill.

10 30. The currency handling device of claim 29 wherein the alternative output receptacle is the output receptacle to which no call bills are transported pursuant to the selected mode of operation.

31. The method of claim 25 further comprising receiving input from a user of the  
15 currency handling device specifying the particular one of the plurality of output receptacles to be disabled.

32. The method of claim 25 further comprising receiving input from a user of the  
20 currency processing device specifying which of the plurality of output receptacles is the alternative output receptacle.

**ABSTRACT**

A currency handling device for rapidly processing a plurality of currency bills comprises an input receptacle adapted to receive the currency bills to be processed, a  
5 plurality of output receptacles adapted to receive the bills after the bills have been processed, a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the plurality of output receptacles, an evaluating unit that is adapted to determine information concerning the bills, and a controller. The evaluation unit includes at least one sensor positioned along the transport path between  
10 the input receptacle and the plurality of output receptacles. The controller is adapted to operate the currency handling device according to a mode of operation wherein the mode of operation designates the output receptacle to which each of the bills are transported based on the determined information concerning the bill. The controller is adapted to disable at least one of the plurality of output receptacles. The controller is adapted to cause the transport  
15 mechanism to direct bills directed to the disabled one of the plurality of output receptacles pursuant to the mode of operation to an alternative output receptacle.

**Allowed Claims – 47171-00261USC1 (CUMM:261-1)**

**U.S. Patent Application No. 09/453,200**

238. A method of processing currency bills using a U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device;  
transporting the bills, one at a time, from the input receptacle along a transport path;

automatically denominating bills of a plurality of U.S. denominations;  
delivering bills which have been evaluated to an output region comprising one and only one stacker wheel containing output receptacle.

239. The method of claim 238 wherein comprising receiving bills of a plurality of denominations in the input receptacle and transporting bills of a plurality of denominations to the stacker wheel containing output receptacle.

240. The method of claim 238 wherein the stacker wheel comprises flexible blades.

241. The method of claim 238 wherein automatically denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response to the reflected light characteristic information output signal.

242. The method of claim 238 wherein the transporting and denominating are performed at a rate in excess of about 800 bills per minute.

243. The method of claim 238 wherein bills of at least two of the plurality of denominations have the same size and the denominating comprises denominating bills of

the plurality of denominations including bills of different denominations having the same size.

244. The method of claim 238 wherein the denominating comprises denominating bills independently of the size of the bills.

245. The method of claim 238 wherein each bill is rectangular and has a wide dimension and a narrow dimension and wherein the transporting comprises transporting bills in a transport direction with their narrow dimension parallel to the transport direction.

246. The method of claim 245 wherein the transporting and denominating are performed at a rate in excess of about 800 bills per minute.

247. The method of claim 246 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

248. The method of claim 246 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and wherein the denominating is performed based on the image signals associated with only the reverse-side of bills.

249. The method of claim 238 further comprising printing information based on the results of the denominating.

250. The method of claim 238 further comprising displaying a total value of bills contained in the output receptacle and the number of bills of each of the plurality of denominations contained in the output receptacle.



251. The method of claim 238 comprising transporting bills of a plurality of denominations to the output receptacle.

252. The method of claim 251 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

253. A method of processing currency bills using a U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device;  
transporting the bills, one at a time, from the input receptacle along a transport path;

automatically denominating bills of a plurality of U.S. denominations;  
delivering any bill that has been denominated to one and only one output receptacle.

254. The method claim 253 further comprising restacking bills that have been identified in the output receptacle using a stacking wheel comprising flexible blades.

255. The method of claim 254 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

256. The method of claim 253 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

257. The method of claim 253 wherein the transporting and denominating are performed at a rate in excess of about 800 bills per minute.

258. A method of processing currency bills using a U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device;  
transporting the bills, one at a time, from the input receptacle along a transport path;

automatically denominating bills of a plurality of U.S. denominations;  
restacking bills that have been denominating in a single stack using a stacking mechanism comprising flexible blades.

259. The method of claim 258 wherein bills of at least two of the plurality of denominations have the same size and the denominating comprises denominating bills of the plurality of denominations including bills of different denominations having the same size.

260. The method of claim 258 wherein the denominating comprises denominating bills independently of the size of the bills.

261. The method of claim 258 wherein each bill is rectangular and has a wide dimension and a narrow dimension and wherein the transporting comprises transporting bills in a transport direction with their narrow dimension parallel to the transport direction.

262. The method of claim 261 wherein the transporting and denominating are performed at a rate in excess of about 800 bills per minute.

263. The method of claim 262 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black

side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

264. The method of claim 262 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and wherein the denominating is performed based on the image signals associated with only the reverse-side of bills.

265. The method of claim 258 further comprising printing information based on the results of the denominating.

266. The method of claim 258 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

267. A method of processing currency bills using a U.S. currency evaluation device comprising:

- receiving a stack of bills to be evaluated in an input receptacle of the device;
- transporting the bills, one at a time, from the input receptacle along a transport path;

- automatically denominating bills of a plurality of U.S. denominations; and
- restacking bills that have been denominated in a denominated bill output receptacle using a stacking mechanism comprising flexible blades;

- wherein after processing the entire stack of bills, the denominated bill output receptacle contains a set of bills, all of whose denominations are known.

268. The method of claim 267 wherein bills of at least two of the plurality of denominations have the same size and the denominating comprises denominating bills of

the plurality of denominations including bills of different denominations having the same size.

269. The method of claim 267 wherein the denominating comprises denominating bills independently of the size of the bills.

270. The method of claim 267 wherein each bill is rectangular and has a wide dimension and a narrow dimension and wherein the transporting comprises transporting bills in a transport direction with their narrow dimension parallel to the transport direction.

271. The method of claim 270 wherein the transporting and denominating are performed at a rate in excess of about 800 bills per minute.

272. The method of claim 271 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

273. The method of claim 271 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and wherein the denominating is performed based on the image signals associated with only the reverse-side of bills.

274. The method of claim 267 further comprising printing information based on the results of the denominating.

275. The method of claim 267 further comprising displaying a total value of bills contained in the denominated bill output receptacle and the number of bills of each of the plurality of denominations contained in the denominated bill output receptacle.

277. The method of claim 267 comprising transporting bills of a plurality of denominations to the denominated bill output receptacle and wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

278. A method of processing currency bills using a U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device including bills of a plurality of denominations, each bill being rectangular and having a wide dimension and a narrow dimension;

transporting the bills, one at a time, from the input receptacle along a transport path in a transport direction with their narrow dimension parallel to the transport direction;

automatically denominating bills of a plurality of U.S. denominations; and  
restacking bills that have been denominated in a denominated bill output receptacle using a stacking mechanism comprising flexible blades;

wherein after processing the entire stack of bills, the denominated bill output receptacle contains a set of bills, all of whose denominations are known, including bills of a plurality of denominations.

279. The method of claim 278 wherein bills of at least two of the plurality of denominations have the same size and the denominating comprises denominating bills of the plurality of denominations including bills of different denominations having the same size.

280. The method of claim 278 wherein the denominating comprises denominating bills independently of the size of the bills.

281. The method of claim 278 wherein the transporting and denominating are performed at a rate in excess of about 800 bills per minute.

282. The method of claim 281 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

283. The method of claim 281 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and wherein the denominating is performed based on the image signals associated with only the reverse-side of bills.

284. The method of claim 278 further comprising printing information based on the results of the denominating.

285. The method of claim 278 further comprising displaying a total value of bills contained in the denominated bill output receptacle and the number of bills of each of the plurality of denominations contained in the denominated bill output receptacle.

286. The method of claim 278 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

287. A method of processing currency bills using a high-speed U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device;  
transporting the bills, one at a time, from the input receptacle along a transport path at a rate in excess of 800 bills per minute;

automatically denominating bills of a plurality of U.S. denominations at a rate in excess of 800 bills per minute; and

restacking bills that have been denominated in a denominated bill output receptacle using a stacking mechanism comprising flexible blades;

wherein after processing the entire stack of bills, the denominated bill output receptacle contains a set of bills, all of whose denominations are known.

288. The method of claim 287 comprising transporting bills of a plurality of denominations to the denominated bill output receptacle.

289. The method of claim 288 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

290. The method of claim 287 wherein bills of at least two of the plurality of denominations have the same size and the denominating comprises denominating bills of the plurality of denominations including bills of different denominations having the same size.

291. The method of claim 287 wherein the denominating comprises denominating bills independently of the size of the bills.

292. The method of claim 287 wherein each bill is rectangular and has a wide dimension and a narrow dimension and wherein the transporting comprises transporting bills in a transport direction with their narrow dimension parallel to the transport direction.

293. The method of claim 287 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black

side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

294. The method of claim 287 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and wherein the denominating is performed based on the image signals associated with only the reverse-side of bills.

295. The method of claim 287 further comprising printing information based on the results of the denominating.

296. The method of claim 287 further comprising displaying a total value of bills contained in the output receptacle and the number of bills of each of the plurality of denominations contained in the output receptacle.

297. A method of processing currency bills using a high-speed U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device, the bills having a narrow dimension;

transporting the bills, one at a time, from the input receptacle along a transport path in a transport direction at a rate in excess of 800 bills per minute with their narrow dimension parallel to the transport direction;

automatically denominating bills of a plurality of U.S. denominations at a rate in excess of 800 bills per minute; and

delivering to an output receptacle (a) bills that have been automatically denominated and (b) all bills that have not been automatically denominated and which remain undenominated when delivered to the output receptacle.

299. The method of claim 297 wherein the denominating comprises denominating bills independently of the size of the bills.



300. The method of claim 297 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

301. The method of claim 297 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and wherein the denominating is performed based on the image signals associated with only the reverse-side of bills.

302. The method of claim 297 further comprising printing information based on the results of the denominating.

303. The method of claim 297 further comprising displaying a total value of bills contained in the output receptacle and the number of bills of each of the plurality of denominations contained in the output receptacle.

304. The method of claim 297 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

305. A method of processing currency bills using a high-speed U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device;  
transporting the bills, one at a time, from the input receptacle along a transport path at a rate in excess of 800 bills per minute;

automatically denominating bills of a plurality of U.S. denominations at a rate in excess of 800 bills per minute; and

receiving bills after evaluation in one and only one stacker wheel containing output receptacle and forming a single stack of U.S. bills.

306. The method of claim 305 wherein bills of at least two of the plurality of denominations have the same size and the denominating comprises denominating bills of the plurality of denominations including bills of different denominations having the same size.

307. The method of claim 305 wherein the denominating comprises denominating bills independently of the size of the bills.

308. The method of claim 305 wherein each bill is rectangular and has a wide dimension and a narrow dimension and wherein the transporting comprises transporting bills in a transport direction with their narrow dimension parallel to the transport direction.

309. The method of claim 305 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

310. The method of claim 305 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and wherein the denominating is performed based on the image signals associated with only the reverse-side of bills.

311. The method of claim 305 further comprising printing information based on the results of the denominating.

312. The method of claim 305 further comprising displaying a total value of bills contained in the output receptacle and the number of bills of each of the plurality of denominations contained in the output receptacle.

313. The method of claim 305 comprising transporting bills of a plurality of denominations to the output receptacle.

314. The method of claim 313 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

315. A method of processing currency bills using a high-speed U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device;  
transporting the bills, one at a time, from the input receptacle along a transport path at a rate in excess of 800 bills per minute;  
automatically denominating and totaling bills of a plurality of U.S. denominations at a rate in excess of 800 bills per minute; and  
delivering any bill that has been successfully evaluated and totaled to one and only one output receptacle.

317. The method of claim 315 wherein the denominating comprises denominating bills independently of the size of the bills.

318. The method of claim 315 wherein each bill is rectangular and has a wide dimension and a narrow dimension and wherein the transporting comprises transporting bills in a transport direction with their narrow dimension parallel to the transport direction.

319. The method of claim 315 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

320. The method of claim 315 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and wherein the denominating is performed based on the image signals associated with only the reverse-side of bills.

324. The method of claim 315 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

325. A method of processing currency bills using a U.S. currency evaluation device comprising:

- receiving a stack of bills to be evaluated in an input receptacle of the device;
- transporting the bills, one at a time, from the input receptacle along a transport path;

- automatically denominating bills of a plurality of U.S. denominations by detecting light reflected off passing bills; and

- delivering any bill that has been denominated to one and only one output receptacle.

326. The method of claim 325 wherein the denominating comprises denominating bills independently of the size of the bills.

327. The method of claim 325 wherein each bill is rectangular and has a wide dimension and a narrow dimension and wherein the transporting comprises transporting

bills in a transport direction with their narrow dimension parallel to the transport direction.

328. The method of claim 327 wherein the transporting and denominating are performed at a rate in excess of about 800 bills per minute.

329. The method of claim 328 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

330. The method of claim 328 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and wherein the denominating is performed based on the image signals associated with only the reverse-side of bills.

331. The method of claim 325 further comprising printing information based on the results of the denominating.

332. The method of claim 325 further comprising displaying a total value of bills contained in the output receptacle and the number of bills of each of the plurality of denominations contained in the output receptacle.

333. The method of claim 325 comprising transporting bills of a plurality of denominations to the output receptacle.

334. A method of processing currency bills using a U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device;

transporting the bills, one at a time, from the input receptacle along a transport path;

automatically denominating and totaling bills of a plurality of U.S. denominations; and

delivering any bill that has been denominated and totaled to one and only one output receptacle and stacking any bill that has been denominated in the output receptacle.

335. The method of claim 334 wherein the stacking is performed using a stacker wheel associated with the output receptacle and comprising transporting bills of a plurality of denominations to the stacker wheel.

336. The method of claim 334 wherein the denominating comprises denominating bills independently of the size of the bills.

337. The method of claim 334 wherein each bill is rectangular and has a wide dimension and a narrow dimension and wherein the transporting comprises transporting bills in a transport direction with their narrow dimension parallel to the transport direction.

338. The method of claim 337 wherein the transporting and denominating are performed at a rate in excess of about 800 bills per minute.

339. The method of claim 338 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

340. The method of claim 338 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and

wherein the denominating is performed based on the image signals associated with only the reverse-side of bills.

341. The method of claim 334 further comprising printing information based on the results of the denominating.

342. The method of claim 334 further comprising displaying a total value of bills contained in the output receptacle and the number of bills of each of the plurality of denominations contained in the output receptacle.

343. The method of claim 334 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

344. A method of processing currency bills using a high-speed U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device, the bills having a narrow dimension;

transporting the bills, one at a time, from the input receptacle along a transport path in a transport direction at a rate in excess of 800 bills per minute with their narrow dimension parallel to the transport direction; and

automatically denominating bills of a plurality of U.S. denominations at a rate in excess of 800 bills per minute.

345. The method of claim 344 further comprising delivering bills after evaluation to one and only one stacker wheel containing output receptacle.

346. The method of claim 344 further comprising delivering bills after evaluation to at least one output receptacle.

347. The method of claim 346 wherein the delivering comprises delivering bills after evaluation to a single output receptacle.

348. The method of claim 344 wherein the transporting and the denominating are performed at a rate in excess of about 1000 bills per minute.

349. The method of claim 344 wherein the denominating comprises scanning passing bills, each along a single segment.

350. The method of claim 349 further comprising successively sampling an output of a detector as it scans a bill along the segment.

351. The method of claim 344 wherein the denominating comprises denominating bills independently of the size of the bills.

353. The method of claim 344 wherein the denominating comprises scanning passing bills and generating image signals and wherein each of the U.S. bills has a black side and a green side associated therewith and wherein the denominating is performed based on the image signals associated with only the green side of bills.

354. The method of claim 344 further comprising printing information based on the results of the denominating.

355. The method of claim 344 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

356. A method of processing currency bills using a high-speed U.S. currency evaluation device comprising:



receiving a stack of bills having a plurality of U.S. denominations to be evaluated in an input receptacle of the device, the bills having a narrow dimension;

transporting the bills, one at a time, from the input receptacle along a transport path in a transport direction at a rate in excess of 800 bills per minute with their narrow dimension parallel to the transport direction; and

automatically denominating bills of a plurality of U.S. denominations at a rate in excess of 800 bills per minute, the bills being denominating having images associated therewith corresponding to the plurality of denominations, wherein the denominating comprises scanning passing bills using a detector and generating image signals and determining the denomination of the bills based on the image signals.

357. The method of claim 356 further comprising delivering bills after evaluation to at least one output receptacle.

358. The method of claim 357 further comprising displaying the total value of bills contained in the at least one output receptacle and the number of bills of each of the plurality of denominations contained in the at least one output receptacle.

359. The method of claim 356 comprising delivering bills after evaluation to one and only one stacker wheel containing output receptacle.

360. The method of claim 356 wherein each of the U.S. bills has a black side and a green side associated therewith and wherein the denominating is based on the image signals associated with only the green side of bills.

362. The method of claim 356 wherein each of the U.S. bills has a portrait-side and a reverse-side opposite the portrait-side associated therewith and wherein the denominating is based on the image signals associated with only the reverse-side of bills.

363. The method of claim 360 wherein each of the U.S. bills has a portrait-side and a non-portrait-side associated therewith and wherein the denominating is based on the image signals associated with only the non-portrait-side of bills.

364. The method of claim 356 comprising delivering bills after evaluation to a single output receptacle.

365. The method of claim 356 wherein the transporting and the denominating are performed at a rate in excess of about 1000 bills per minute.

366. The method of claim 356 wherein the scanning is performed along a single segment of each passing bill.

367. The method of claim 366 comprising successively sampling an output of the detector as it scans a bill along the segment.

368. The method of claim 356 wherein the denominating comprises denominating bills independently of the size of the bills.

369. The method of claim 356 wherein the denominating comprises detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto.

370. A method of processing currency bills using a U.S. currency evaluation device comprising:

receiving a stack of bills having a plurality of U.S. denominations to be evaluated in an input receptacle of the device, the bills having a narrow dimension;

transporting the bills, one at a time, from the input receptacle along a transport path in a transport direction with their narrow dimension parallel to the transport direction; and

automatically denominating bills of a plurality of U.S. denominations at a rate in excess of 800 bills per minute, each of the U.S. bills being denominated having a black side and a green side and the black side and the green side having images associated therewith corresponding to the plurality of denominations, wherein the denominating comprises scanning passing bills using a detector and generating image signals and determining the denomination of the U.S. bills based on the image signals associated with only the green side of bills.

371. The method of claim 370 further comprising delivering bills after evaluation to at least one output receptacle.

372. The method of claim 370 further comprising delivering bills after evaluation to one and only one stacker wheel containing output receptacle.

373. The method of claim 370 further comprising delivering bills after evaluation to a single output receptacle.

374. The method of claim 370 wherein the transporting and the denominating are performed at a rate in excess of about 1000 bills per minute.

375. The method of claim 370 wherein the scanning is performed along a single segment of each passing bill.

376. The method of claim 375 comprising successively sampling an output of the detector as it scans a bill along the segment.

378. A method of processing currency bills using a high-speed U.S. currency evaluation device comprising:

receiving a stack of bills to be evaluated in an input receptacle of the device, the bills having a narrow dimension;

transporting the bills, one at a time, from the input receptacle along a transport path in a transport direction at a rate in excess of 800 bills per minute with their narrow dimension parallel to the transport direction;

automatically denominating bills of a plurality of U.S. denominations at a rate in excess of 800 bills per minute; and

delivering to an output receptacle comprising a stacking wheel (a) bills that have been automatically denominating and (b) all bills that have not been automatically denominating and which remain undenominated when delivered to the output receptacle.

379. The method of claim 344 further comprising delivering bills to a stacking mechanism comprising a plurality of blades.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re continuation of: )  
)  
Application of: Donald E. Raterman et. al. )  
Serial No. 08/841,203 ) Atty. Docket: CUMM 261---  
Filed: April 29, 1997 )  
November 25, 1998 (CPA) )  
Group Art Unit: 2721 )  
)  
For: Method And Apparatus For )  
Currency Discrimination )  
And Counting )

**PRELIMINARY AMENDMENT "A"**

Honorable Commissioner of  
Patents and Trademarks  
Washington, D.C. 20231

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"Express Mail"

I hereby certify that this correspondence is being deposited under Express Mailing No. EM580074635US, in an envelope addressed to Box Patent Application, Assistant Commissioner of Patents and Trademarks, Washington, D.C. 20231, on:

Date of Deposit: December 2, 1999

*Maureen Thullast-Hammonds*

Dear Sir:

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This application is a continuing application of pending prior application Serial No. 08/841,203, filed April 29, 1997 entitled "Method And Apparatus For Currency Discrimination And Counting." Application Serial No. 08/841,203 is a continuation of 08/339,337, filed on November 14, 1994, entitled "Method And Apparatus For Currency Discrimination And Counting" and issued as U.S. Pat. No. 5,692,067, which in turn is a continuation of 08/127,334, filed on September 27, 1993, and issued as U.S. Pat. No. 5,467,405, which in turn is a continuation of application Serial No. 07/885,648, filed May 19, 1992, and issued as Patent No. 5,295,196 on March 15, 1994, which in turn is a continuation-in-part of application Serial No. 07/475,111, filed February 5, 1990, and now abandoned.

IN THE SPECIFICATION:

Please amend the specification by deleting the cross-reference section at page 1, lines 3-5 and inserting therefore the following:

-- This application is a continuing application of pending prior application Serial No. 08/841,203, filed April 29, 1997 entitled "Method And Apparatus For Currency Discrimination And Counting." Application Serial No. 08/841,203 is a continuation of 08/339,337, filed on November 14, 1994, and issued as U.S. Pat. No. 5,692,067, which in turn is a continuation of 08/127,334, filed on September 27, 1993, and issued as U.S. Pat. No. 5,467,405, which in turn is a continuation of application Serial No. 07/885,648, filed May 19, 1992, and issued as Patent No. 5,295,196 on March 15, 1994, which in turn is a continuation-in-part of application Serial No. 07/475,111, filed February 5, 1990, and now abandoned.--

IN THE CLAIMS:

Cancel claims 1-18 and 20-27.

Please add the following new claims 28-77:

28. A U.S. currency evaluation device for receiving a stack of U.S. currency bills and rapidly evaluating all the bills in the stack, the device comprising:  
 an input receptacle positioned to receive a stack of bills to be evaluated;  
 a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of U.S. denominations.

29. The currency evaluation device of claim 28 wherein the detector is adapted to detect reflected light and generate a reflected light characteristic output signal.

30. The currency evaluation device of claim 29 wherein the discriminating unit is adapted to denominate bills based solely on the detection of reflected light.

31. The currency evaluation device of claim 28 wherein the detector is an optical detector adapted to generate an optical characteristic output signal.

32. The currency evaluation device of claim 31 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate of at least about 800 bills per minute.

33. The currency evaluation device of claim 31 wherein the discriminating unit is adapted to denominate bills based solely on the detection of optical characteristic information.

34. The currency evaluation device of claim 33 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate of at least about 1000 bills per minute.

35. The currency evaluation device of claim 28 wherein the processor is adapted to generate a scanned pattern from each of the bills based on the characteristic information output signal and determine the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

36. A U.S. currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:  
a single input receptacle positioned to receive a stack of bills to be evaluated;  
a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of U.S. denominations; and

a flagging device comprising the processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills, the processor generating a no call signal when the denomination of a bill is not determined by the processor.

37. The currency evaluation device of claim 36 wherein the processor is coupled to the transport mechanism and is programmed to cause the transport mechanism to halt when the denomination of a bill is not determined by the processor.

38. The currency evaluation device of claim 36 wherein the processor generates a scanned pattern from each of the bills based on the characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of U.S. bills, the master patterns being stored in a memory.

39. The currency evaluation device of claim 38 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

40. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:



a single input receptacle positioned to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of denominations independently of the dimensions of the bills.

41. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

a single input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor, the discriminating unit counting and determining the denomination of the bills;

wherein the processor is programmed to flag a bill when the denomination of the bill is not determined by the discriminating unit, the processor generating a no call signal when the denomination of a bill is not determined by the processor, and

wherein the processor is coupled to the transport mechanism and is programmed to cause the transport mechanism to halt when the denomination of a bill is not determined.

42. The device of claim 41 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position.

43. The device of claim 41 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being the last bill transported to the output receptacle.

44. The device of claim 41 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position within the output receptacle.

45. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- a input receptacle positioned to receive a stack of bills to be evaluated;
- a single output receptacle positioned to receive the bills after the bills have been evaluated;

- a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

- a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of denominations, bills of at least two of the plurality of denominations having the same size; and

a flagging device comprising the processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills, the processor generating a no call signal when the denomination of a bill is not determined by the processor.

46. The currency evaluation device of claim 45 wherein the processor generates a scanned pattern from each of the bills based on the characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

47. The currency evaluation device of claim 46 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

48. A high-speed compact, single input receptacle, single output receptacle currency denominating device for receiving a stack of currency bills having a plurality of denominations and rapidly denominating the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills in the direction of the narrow dimension of the bills, one at a time, from the input receptacle to the output receptacle along a transport path at a rate in excess of about 800 bills per minute;

a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations at a rate in excess of about 800 bills per minute, bills of at least two of the denominations having the same dimensions, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle, the discriminating unit counting and determining the denomination of the bills.

49. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

a single input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations by scanning images associated with each of the bills, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor, the discriminating unit counting and determining the denomination of the bills;

wherein the processor is programmed to flag a bill when the denomination of the bill is not determined by the discriminating unit; and wherein the processor is programmed to generate a no call signal when the denomination of a bill is not determined by the processor.

50. The device of claim 49 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position.

51. The device of claim 49 wherein is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being the last bill delivered to the output receptacle.

52. The device of claim 49 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position within the output receptacle.

53. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating an image characteristic information output signal in response to detected characteristic information, the output signal being associated with images associated with the bills, the characteristic information output signal being electrically coupled to the processor, the processor receiving the image characteristic information output signal and generating a denomination signal in response thereto.

54. The currency evaluation device of claim 53 wherein the detector is adapted to detect reflected light and generate a reflected light characteristic output signal.

55. The currency evaluation device of claim 54 wherein the discriminating unit is adapted to denominate bills based solely on the detection of reflected light.

56. The currency evaluation device of claim 53 wherein the detector is an optical detector adapted to generate an optical characteristic output signal.

57. The currency evaluation device of claim 56 wherein the discriminating unit is adapted to denominate bills based solely on the detection of optical characteristic information.

58. The currency evaluation device of claim 57 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate of at least about 800 bills per minute.

59. The currency evaluation device of claim 53 wherein the processor is adapted to generate a scanned pattern from each of the bills based on the characteristic information output signal and determine the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

60. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- an input receptacle positioned to receive a stack of bills to be evaluated;

- a single output receptacle positioned to receive the bills after the bills have been evaluated;

- a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

- a discriminating unit comprising an image detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating an image characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the image characteristic information output signal and generating a denomination signal in response thereto; and

- a flagging device comprising the processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills, the processor generating a no call signal when the denomination of a bill is not determined by the processor.

61. The currency evaluation device of claim 60 wherein the processor generates a scanned pattern from each of the bills based on the characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

62. The currency evaluation device of claim 61 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

63. A high-speed compact, single input receptacle, single output receptacle currency denominating device for receiving a stack of currency bills having a plurality of denominations and rapidly denominating the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills in the direction of the narrow dimension of the bills, one at a time, from the input receptacle to the output receptacle along a transport path at a rate in excess of about 800 bills per minute;

a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations at a rate in excess of about 800 bills per minute, the bills the discriminating unit is adapted to denominate having images associated therewith corresponding to the plurality of denominations that the discriminating unit is adapted to denominate, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle, the detector being adapted to scan passing bills and generate image signals, the discriminating unit determining the denomination of the bills based on the image signals.

64. A method of processing U.S. currency using a U.S. currency denominating device having a single input receptacle and a single output receptacle comprising:

receiving a stack of U.S. bills having a plurality of denominations to be evaluated in a single input receptacle of the currency denominating device;

receiving the bills in a single output receptacle of the currency denominating device after the bills have been evaluated;

transporting the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path;

determining the denomination of each of the bills including bills of a plurality of U.S. denominations.

65. A method of processing U.S. currency using a U.S. currency evaluation device having a single input receptacle and a single output receptacle comprising:

receiving a stack of U.S. bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device;

receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path;

determining the denomination of each of the bills including bills of a plurality of U.S. denominations using a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor;

flagging a bill when the denomination of the bill is not determined by the discriminating unit by halting the transporting of the bills.

66. The method of claim 65 comprising halting the transporting with the bill whose denomination has not been determined being located at a predetermined position.

67. The method of claim 65 comprising halting the transporting with the bill whose denomination has not been determined being the last bill delivered to the output receptacle.

68. A method of processing currency using a currency evaluation device comprising:

receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device;



receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

determining the denomination of each of the bills including bills of a plurality of denominations having the same size using a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor;

flagging a bill when the denomination of the bill is not determined by the discriminating unit by generating a no call signal.

69. The method of claim 68 comprising halting the transporting with the bill whose denomination has not been determined being located at a predetermined position in response to the generation of a no call signal.

70. The method of claim 68 comprising halting the transporting with the bill whose denomination has not been determined being the last bill delivered to the output receptacle in response to the generation of a no call signal.

71. A method of processing currency using a currency evaluation device comprising:

receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device, bills of at least two of the plurality of denominations having the same dimensions;

receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to the output receptacle along a transport path using a transport mechanism comprising a transport drive motor and transport rollers;

determining, independently of the size of the bills, the denomination of each of the bills including bills of a plurality of denominations using a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor; wherein determining the denomination comprises:

the detector detecting characteristic information from the bills;  
 the detector generating a characteristic information output signal in  
 response to detected characteristic information, the characteristic information  
 output signal being electrically coupled to the processor;  
 the processor receiving the characteristic information output signal;  
 and  
 the processor generating a denomination signal in response thereto.

72. A method of processing currency bills having a plurality of denominations using a currency denominating device having a single input receptacle and a single output receptacle comprising:

receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle;

receiving the bills after the bills have been evaluated in a single output receptacle of the device;

transporting the bills in the direction of the narrow dimension of the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path at a rate in excess of about 800 bills per minute; and

counting and denominating the bills including bills of a plurality of denominations at a rate in excess of about 800 bills per minute, denominating comprising scanning images associated with the bills.

73. A method of processing currency using a currency evaluation device comprising:

receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device;

receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path;

scanning the bills and retrieving images associated therewith;

determining the denomination of each of the bills using the retrieved images, wherein determining the denomination comprises using a discriminating unit

comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor;

flagging a bill when the denomination of the bill is not determined by the discriminating unit by generating a no call signal.

74. The method of claim 73 comprising halting the transporting in response to the generation of a no call signal with the bill whose denomination has not been determined being located at a predetermined position.

75. The method of claim 73 comprising halting the transporting in response to the generation of a no call signal with the bill whose denomination has not been determined being the last bill delivered to the output receptacle.

76. A U.S. currency evaluation device for receiving a stack of U.S. currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

one and only one stacker wheel containing output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of U.S. denominations.

77. A U.S. currency evaluation device for receiving a stack of U.S. currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

an output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of U.S. denominations;

wherein the device is adapted to deliver any bill that has been denominated to one and only one output receptacle.

#### **REMARKS**

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## S P E C I F I C A T I O N

We, Donald R. Raterman, Bradford T. Graves, and Aaron M. Bauch, citizens respectively of the United States of America, and Lars R. Stromme, citizen of Norway, and residing respectively at 1345 Carol Lane, Deerfield, Illinois 60015, 4173 Bloomington Avenue, #204, Arlington Heights, Illinois 60004, 36 Buckingham Meadow, East Setauket, New York 11733, and 2403 East Olive Street, Arlington Heights, Illinois 60004, have invented a certain new and useful **METHOD AND APPARATUS FOR CURRENCY DISCRIMINATION AND COUNTING** of which the following is a specification.

## METHOD AND APPARATUS FOR CURRENCY

### DISCRIMINATION AND COUNTING

#### **CROSS-REFERENCE TO RELATED APPLICATION**

This application is a continuation-in-part of pending United States patent application Serial No. 07/475,111, filed February 5, 1990, for "Method and  
5 Apparatus for Currency Discrimination and Counting."

#### **BACKGROUND OF THE INVENTION**

##### **Field of the Invention**

The present invention relates, in general, to currency identification. The invention relates more particularly to a method and apparatus for automatic  
10 discrimination and counting of currency bills of different denominations using light reflectivity characteristics of indicia printed upon the currency bills.

##### **Description of the Related Art**

A variety of techniques and apparatus have been used to satisfy the requirements of automated currency handling systems. At the lower end of  
15 sophistication in this area of technology are systems capable of handling only a specific type of currency, such as a specific dollar denomination, while rejecting all other currency types. At the upper end are complex systems which are capable of identifying and discriminating among and automatically counting multiple currency denominations.

Currency discrimination systems typically employ either magnetic sensing or optical sensing for discriminating between different currency denominations. Magnetic sensing is based on detecting the presence or absence of magnetic ink

in portions of the printed indicia on the currency by using magnetic sensors, usually ferrite core-based sensors, and using the detected magnetic signals, after undergoing analog or digital processing, as the basis for currency discrimination. The more commonly used optical sensing technique, on the other hand, is based on detecting and analyzing variations in light reflectance or transmissivity characteristics occurring when a currency bill is illuminated and scanned by a strip of focused light. The subsequent currency discrimination is based on the comparison of sensed optical characteristics with prestored parameters for different currency denominations, while accounting for adequate tolerances reflecting differences among individual bills of a given denomination.

A major obstacle in implementing automated currency discrimination systems is obtaining an optimum compromise between the criteria used to adequately define the characteristic pattern for a particular currency denomination, the time required to analyze test data and compare it to predefined parameters in order to identify the currency bill under scrutiny, and the rate at which successive currency bills may be mechanically fed through and scanned. Even with the use of microprocessors for processing the test data resulting from the scanning of a bill, a finite amount of time is required for acquiring samples and for the process of comparing the test data to stored parameters to identify the denomination of the bill.

Most of the optical scanning systems available today utilize complex algorithms for obtaining a large number of reflectance data samples as a currency bill is scanned by an optical scanhead and for subsequently comparing the data to corresponding stored parameters to identify the bill denomination. Conventional

systems require a relatively large number of optical samples per bill scan in order to sufficiently discriminate between currency denominations, particularly those denominations for which the reflectance patterns are not markedly distinguishable. The use of the large number of data samples slows down the rate at which incoming bills may be scanned and, more importantly, requires a correspondingly longer period of time to process the data in accordance with the discrimination algorithm.

A major problem associated with conventional systems is that, in order to obtain the required large number of reflectance samples required for accurate currency discrimination, such systems are restricted to scanning bills along the longer dimension of currency bills. Lengthwise scanning, in turn, has several inherent drawbacks including the need for an extended transport path for relaying the bill lengthwise across the scanhead and the added mechanical complexity involved in accommodating the extended path as well as the associated means for ensuring uniform, non-overlapping registration of bills with the sensing surface of the scanhead.

The end result is that systems capable of accurate currency discrimination are costly, mechanically bulky and complex, and generally incapable of both currency discrimination and counting at high speeds with a high degree of accuracy.

### SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide an improved method and apparatus for identifying and counting currency bills comprising a plurality of currency denominations.



It is another object of this invention to provide an improved method and apparatus of the above kind which is capable of efficiently discriminating among and counting bills of several currency denominations at a high speed and with a high degree of accuracy.

5           A related object of the present invention is to provide such an improved currency discrimination and counting apparatus which is compact, economical, and has uncomplicated construction and operation.

          Briefly, in accordance with the present invention, the objectives enumerated above are achieved by means of an improved optical sensing and correlation technique adopted to both counting and denomination discrimination  
10           of currency bills. The technique is based on the optical sensing of bill reflectance characteristics obtained by illuminating and scanning a bill along its narrow dimension, approximately about the central section of the bill. Light reflected from the bill as it is optically scanned is detected and used as an analog  
15           representation of the variation in the dark and light content of the printed pattern or indicia on the bill surface.

          A series of such detected reflectance signals are obtained by sampling and digitally processing, under microprocessor control, the reflected light at a plurality of predefined sample points as the bill is moved across the illuminated strip with  
20           its narrow dimension parallel to the direction of transport of the bill.

          Accordingly, a fixed number of reflectance samples is obtained across the narrow dimension of the note. The data samples obtained for a bill scan are subjected to digital processing, including a normalizing process to deaccentuate variations due to "contrast" fluctuations in the printed pattern or indicia existing on the surface

of the bill being scanned. The normalized reflectance data represent a characteristic pattern that is fairly unique for a given bill denomination and incorporates sufficient distinguishing features between characteristic patterns for different currency denominations so as to accurately differentiate therebetween.

5 By using the above approach, a series of master characteristic patterns are generated and stored using standard bills for each denomination of currency that is to be detected. The "standard" bills used to generate the master characteristic patterns are preferably bills that are slightly used bills. According to a preferred embodiment, two characteristic patterns are generated and stored within system  
10 memory for each detectable currency denomination. The stored patterns correspond, respectively, to optical scans performed on the green surface of a bill along "forward" and "reverse" directions relative to the pattern printed on the bill. For bills which produce significant pattern changes when shifted slightly to the left or right, such as the \$10 bill in U.S. currency, it is preferred to store two  
15 patterns for each of the "forward" and "reverse" directions, each pair of patterns for the same direction represent two scan areas that are slightly displaced from each other along the long dimension of the bill. Preferably, the currency discrimination and counting method and apparatus of this invention is adapted to identify seven (7) different denominations of U.S. currency, i.e., \$1, \$2, \$5, \$10,  
20 \$20, \$50 and \$100. Accordingly, a master set of 16 different characteristic patterns is stored within the system memory for subsequent correlation purposes (four patterns for the \$10 bill and two patterns for each of the other denominations.

According to the correlation technique of this invention, the pattern generated by scanning a bill under test and processing the sampled data is compared with each of the 16 prestored characteristic patterns to generate, for each comparison, a correlation number representing the extent of similarity between corresponding ones of the plurality of data samples for the compared patterns. Denomination identification is based on designating the scanned bill as belonging to the denomination corresponding to the stored characteristic pattern for which the correlation number resulting from pattern comparison is determined to be the highest. The possibility of a scanned bill having its denomination mischaracterized following the comparison of characteristic patterns, is significantly reduced by defining a bi-level threshold of correlation that must be satisfied for a "positive" call to be made.

In essence, the present invention provides an improved optical sensing and correlation technique for positively identifying any of a plurality of different bill denominations regardless of whether the bill is scanned along the "forward" or "reverse" directions. The invention is particularly adapted to be implemented with a system programmed to track each identified currency denomination so as to conveniently present the aggregate total of bills that have been identified at the end of a scan run. Also in accordance with this invention, currency detecting and counting apparatus is disclosed which is particularly adapted for use with the novel sensing and correlation technique summarized above. The apparatus incorporates an abbreviated curved transport path for accepting currency bills that are to be counted and transporting the bills about their narrow dimension across a scanhead located downstream of the curved path and onto a

conventional stacking station where sensed and counted bills are collected. The scanhead operates in conjunction with an optical encoder which is adapted to initiate the capture of a predefined number of reflectance data samples when a bill (and, thus, the indicia or pattern printed thereupon) moves across a coherent strip of light focused downwardly of the scanhead.

The scanhead uses a pair of light-emitting diodes ("LED"s) to focus a coherent light strip of predefined dimensions and having a normalized distribution of light intensity across the illuminated area. The LED's are angularly disposed and focus the desired strip of light onto the narrow dimension of a bill positioned flat across the scanning surface of the scanhead. A photo detector detects light reflected from the bill. The photo detector is controlled by the optical encoder to obtain the desired reflectance samples.

Initiation of sampling is based upon detection of the change in reflectance value that occurs when the outer border of the printed pattern on a bill is encountered relative to the reflectance value obtained at the edge of the bill where no printed pattern exists. According to a preferred embodiment of this invention, illuminated strips of at least two different dimensions are used for the scanning process. A narrow strip is used initially to detect the starting point of the printed pattern on a bill and is adapted to distinguish the thin borderline that typically marks the starting point of and encloses the printed pattern on a bill. For the rest of the narrow dimension scanning following detection of the border line of the printed pattern, a substantially wider strip of light is used to collect the predefined number of samples for a bill scan the generation and storage of characteristic patterns using standard notes and the subsequent comparison and

correlation procedure for classifying the scanned bill as belonging to one of several predefined currency denominations is based on the above-described sensing and correlation technique.

#### **Brief Description Of The Drawings**

5           Other objects and advantages of the invention will become apparent upon reading the following detailed description in conjunction with the drawings in which:

FIG. 1 is a functional block diagram illustrating the conceptual basis for the optical sensing and correlation method and apparatus, according to the system  
10 of this invention;

FIG. 1A is a diagrammatic perspective illustration of the successive areas scanned during the traversing movement of a single bill across the scanhead;

FIG. 1B is a perspective view of a bill and the preferred area to be scanned on the bill;

15           FIG. 1C is a diagrammatic side elevation of the scan areas illustrated in FIG. 1A, to show the overlapping relationship of those areas;

FIG. 2 is a block diagram illustrating a preferred circuit arrangement for processing and correlating reflectance data according to the optical sensing and counting technique of this invention;

20           FIGS. 3-8A are flow charts illustrating the sequence of operations involved in implementing the optical sensing and correlation technique;

FIGS. 9A-C are graphical illustrations of representative characteristic patterns generated by narrow dimension optical scanning of a currency bill;

FIGS. 10A-E are graphical illustrations of the effect produced on correlation pattern by using the progressive shifting technique, according to an embodiment of this invention;

5 FIG. 11 is a perspective view showing currency discrimination and counting apparatus particularly adapted to and embodying the optical sensing and correlation technique of this invention;

FIG. 12 is a partial perspective view illustrating the mechanism used for separating currency bills and injecting them in a sequential fashion into the transport path;

10 FIG. 13 is a side view of the apparatus of FIG. 11 illustrating the separation mechanism and the transport path;

FIG. 14 is a side view of the apparatus of FIG. 11 illustrating details of the drive mechanism;

15 FIG. 15 is a top view of the currency discriminating and counting apparatus shown in FIGS. 11-14;

FIG. 16 is an exploded top perspective view of the optical scanhead used in the system of FIGS. 1-15;

20 FIG. 17 is a bottom perspective view of the scanhead of FIG. 16, with the body portion of the scanhead sectioned along a vertical plane passing through the wide slit at the top of the scanhead;

FIG. 18 is a bottom perspective view of the scanhead of FIG. 16, with the body portion of the scanhead sectioned along a vertical plane passing through the narrow slit at the top of the scanhead;

FIG. 19 is an illustration of the light distribution produced about the optical scanhead; and

FIG. 20 is a diagrammatic illustration of the location of two auxiliary photo sensors relative to a bill passed thereover by the transport mechanism shown in FIGS. 11-15; and

FIGS. 21-23 are flow charts illustrating the sequence of operations involved in various enhancements to the operating program for the basic optical sensing and correlation process.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, there is shown a functional block diagram illustrating the optical sensing and correlation system according to this invention. The system 10 includes a bill accepting station 12 where stacks of currency bills that need to be identified and counted are positioned. Accepted bills are acted upon by a bill separating station 14 which functions to pick out or separate one bill at a time for being sequentially relayed by a bill transport mechanism 16, according to a precisely predetermined transport path, across an optical scanhead 18 where the currency denomination of the bill is scanned, identified and

counted at a rate in excess of 800 bills per minute. The scanned bill is then transported to a bill stacking station 20 where bills so processed are stacked for subsequent removal.

5 The optical scanhead 18 comprises at least one light source 22 directing a beam of coherent light downwardly onto the bill transport path so as to illuminate a substantially rectangular light strip 24 upon a currency bill 17 positioned on the transport path below the scanhead 18. Light reflected off the illuminated strip 24 is sensed by a photodetector 26 positioned directly below the strip. The analog output of photodetector 26 is converted into a digital signal by  
10 means of an analog-to-digital (ADC) converter unit 28 whose output is fed as a digital input to a central processing unit (CPU) 30.

According to a feature of this invention, the bill transport path is defined in such a way that the transport mechanism 16 moves currency bills with the narrow dimension "W" of the bills being parallel to the transport path and the  
15 scan direction. Thus, as a bill 17 moves on the transport path on the scanhead 18, the coherent light strip 24 effectively scans the bill across the narrow dimension "W" of the bill. Preferably, the transport path is so arranged that a currency bill 17 is scanned approximately about the central section of the bill along its narrow dimension, as best shown in FIG. 1. The scanhead 18 functions  
20 to detect light reflected from the bill as it moves across the illuminated light strip 24 and to provide an analog representation of the variation in light so reflected which, in turn, represents the variation in the dark and light content of the printed pattern or indicia on the surface of the bill. This variation in light reflected from the narrow dimension scanning of the bills serves as a measure for



distinguishing, with a high degree of confidence, among a plurality of currency denominations which the system of this invention is programmed to handle.

A series of such detected reflectance signals are obtained across the narrow dimension of the bill, or across a selected segment thereof, and the  
5 resulting analog signals are digitized under control of the CPU 30 to yield a fixed number of digital reflectance data samples. The data samples are then subjected to a digitizing process which includes a normalizing routine for processing the sampled data for improved correlation and for smoothing out variations due to "contrast" fluctuations in the printed pattern existing on the bill surface. The  
10 normalized reflectance data so digitized represents a characteristic pattern that is fairly unique for a given bill denomination and provides sufficient distinguishing features between characteristic patterns for different currency denominations, as will be explained in detail below.

In order to ensure strict correspondence between reflectance samples  
15 obtained by narrow dimension scanning of successive bills, the initiation of the reflectance sampling process is preferably controlled through the CPU 30 by means of an optical encoder 32 which is linked to the bill transport mechanism 16 and precisely tracks the physical movement of the bill 17 across the scanhead 18. More specifically, the optical encoder 32 is linked to the rotary motion of the  
20 drive motor which generates the movement imparted to the bill as it is relayed along the transport path. In addition, it is ensured that positive contact is maintained between the bill and the transport path, particularly when the bill is being scanned by the scanhead 18. Under these conditions, the optical encoder is

capable of precisely tracking the movement of the bill relative to the light strip generated by the scanhead by monitoring the rotary motion of the drive motor.

The output of photodetector 26 is monitored by the CPU 30 to initially detect the presence of the bill underneath the scanhead and, subsequently, to  
5 detect the starting point of the printed pattern on the bill, as represented by the thin borderline 17B which typically encloses the printed indicia on currency bills. Once the borderline 17B has been detected, the optical encoder is used to control the timing and number of reflectance samples that are obtained from the output of the photodetector 26 as the bill 17 moves across the scanhead 18 and is  
10 scanned along its narrow dimension.

The detection of the borderline constitutes an important step and realizes improved discrimination efficiency since the borderline serves as an absolute reference point for initiation of sampling. If the edge of a bill were to be used as a reference point, relative displacement of sampling points can occur because of  
15 the random manner in which the distance from the edge to the borderline varies from bill to bill due to the relatively large range of tolerances permitted during printing and cutting of currency bills. As a result, it becomes difficult to establish direct correspondence between sample points in successive bill scans and the discrimination efficiency is adversely affected.

20 The use of the optical encoder for controlling the sampling process relative to the physical movement of a bill across the scanhead is also advantageous in that the encoder can be used to provide a predetermined delay following detection of the borderline prior to initiation of samples. The encoder delay can be adjusted in such a way that the bill is scanned only across those segments

along its narrow dimension which contain the most distinguishable printed indicia relative to the different currency denominations.

In the case of U.S. currency, for instance, it has been determined that the central, approximately two-inch portion of currency bills, as scanned across the  
5 central section of the narrow dimension of the bill, provides sufficient data for distinguishing among the various U.S. currency denominations on the basis of the correlation technique used in this invention. Accordingly, the optical encoder can be used to control the scanning process so that reflectance samples are taken for a set period of time and only after a certain period of time has elapsed since the  
10 borderline has been detected, thereby restricting the scanning to the desired central portion of the narrow dimension of the bill.

FIGS. 1A-1C illustrate the scanning process in more detail. As a bill is advanced in a direction parallel to the narrow edges of the bill, scanning via the wide slit in the scanhead is effected along a segment  $S$  of the central portion of  
15 the bill. This segment  $S$  begins a fixed distance  $d$  inboard of the border line  $B$ . As the bill traverses the scan head, a strip  $s$  of the segment  $S$  is always illuminated, and the photodetector produces a continuous output signal which is proportional to the intensity of the light reflected from the illuminated strip  $s$  at any given instant. This output is sampled at intervals controlled by the encoder,  
20 so that the sampling intervals are precisely synchronized with the movement of the bill across the scanhead.

As illustrated in FIGS. 1A and 1C, it is preferred that the sampling intervals be selected so that the strips  $s$  that are illuminated for successive samples overlap one another. The odd-numbered and even-numbered sample

strips have been separated in FIGS. 1A and 1C to more clearly illustrate this overlap. For example, the first and second strips  $s_1$  and  $s_2$  overlap each other, the second and third strips  $s_2$  and  $s_3$  overlap each other, and so on. Each adjacent pair of strips overlap each other. In the illustrative example, this is accomplished by sampling strips that are 0.050 inch wide at 0.029 inch intervals, along a segment S that is 1.83 inch long (64 samples).

The optical sensing and correlation technique is based upon using the above process to generate a series of master characteristic patterns using standard bills for each denomination of currency that is to be detected. According to a preferred embodiment, two or four characteristic patterns are generated and stored within system memory, preferably in the form of an EPROM 34 (see FIG. 1), for each detectable currency denomination. The characteristic patterns for each bill are generated from optical scans, performed on the green surface of the bill and taken along both the "forward" and "reverse" directions relative to the pattern printed on the bill.

In adapting this technique to U.S. currency, for example, characteristic patterns are generated and stored for seven different denominations of U.S. currency, i.e., \$1, \$2, \$5, \$10, \$20, \$50 and \$100. As explained previously, four characteristic patterns are generated for the \$10 bill, and two characteristic patterns are generated for each of the other denominations. Accordingly, a master set of 16 different characteristic patterns is stored within the system memory for subsequent correlation purposes. Once the master characteristic patterns have been stored, the pattern generated by scanning a bill under test is compared by the CPU 30 with each of the 16 pre-stored master characteristic

patterns to generate, for each comparison, a correlation number representing the extent of correlation, i.e., similarity between corresponding ones of the plurality of data samples, for the patterns being compared.

5 The CPU 30 is programmed to identify the denomination of the scanned bill as corresponding to the stored characteristic pattern for which the correlation number resulting from pattern comparison is found to be the highest. In order to preclude the possibility of mischaracterizing the denomination of a scanned bill, as well as to reduce the possibility of spurious notes being identified as belonging to a valid denomination, a bi-level threshold of correlation is used as the basis for  
10 making a "positive" call, as will be explained in detail below.

Using the above sensing and correlation approach, the CPU 30 is programmed to count the number of bills belonging to a particular currency denomination as part of a given set of bills that have been scanned for a given scan batch, and to determine the aggregate total of the currency amount  
15 represented by the bills scanned during a scan batch. The CPU 30 is also linked to an output unit 36 which is adapted to provide a display of the number of bills counted, the breakdown of the bills in terms of currency denomination, and the aggregate total of the currency value represented by counted bills. The output unit 36 can also be adapted to provide a print-out of the displayed information in  
20 a desired format.

Referring now to FIG. 2, there is shown a representation, in block diagram form, of a preferred circuit arrangement for processing and correlating reflectance data according to the system of this invention. As shown therein, the CPU 30 accepts and processes a variety of input signals including those from the

optical encoder 32, the photodetector 26 and a memory unit 38, which can be an erasable programmable read only memory (EPROM). The memory unit 38 has stored within it the correlation program on the basis of which patterns are generated and test patterns compared with stored master programs in order to identify the denomination of test currency. A crystal 40 serves as the time base for the CPU 30, which is also provided with an external reference voltage  $V_{REF}$  on the basis of which peak detection of sensed reflectance data is performed, as explained in detail below.

The CPU 30 also accepts a timer reset signal from a reset unit 44 which, as shown in FIG. 2A, accepts the output voltage from the photodetector 26 and compares it, by means of a threshold detector 44A, relative to a pre-set voltage threshold, typically 5.0 volts, to provide a reset signal which goes "high" when a reflectance value corresponding to the presence of paper is sensed. More specifically, reflectance sampling is based on the premise that no portion of the illuminated light strip (24 in FIG. 1) is reflected to the photodetector in the absence of a bill positioned below the scanhead. Under these conditions, the output of the photodetector represents a "dark" or "zero" level reading. The photodetector output changes to a "white" reading, typically set to have a value of about 5.0 volts, when the edge of a bill first becomes positioned below the scanhead and falls under the light strip 24. When this occurs, the reset unit 44 provides a "high" signal to the CPU 30 and marks the initiation of the scanning procedure.

In accordance with a feature of this invention, the machine-direction dimension of the illuminated strip of light produced by the light sources within

the scanhead is set to be relatively small for the initial stage of the scan when the thin borderline is being detected. The use of the narrow slit increases the sensitivity with which the reflected light is detected and allows minute variations in the "gray" level reflected off the bill surface to be sensed. This is important in ensuring that the thin borderline of the pattern, i.e., the starting point of the printed pattern on the bill, is accurately detected. Once the borderline has been detected, subsequent reflectance sampling is performed on the basis of a relatively wider light strip in order to completely scan across the narrow dimension of the bill and obtain the desired number of samples, at a rapid rate. The use of a wider slit for the actual sampling also smooths out the output characteristics of the photodetector and realizes the relatively large magnitude of analog voltage which is essential for accurate representation and processing of the detected reflectance values.

Returning to FIG. 2, the CPU 30 processes the output of photodetector 26 through a peak detector 50 which essentially functions to sample the photodetector output voltage and hold the highest, i.e., peak, voltage value encountered after the detector has been enabled. The peak detector is also adapted to define a scaled voltage on the basis of which the pattern borderline on bills is detected. The output of the peak detector 50 is fed to a voltage divider 54 which lowers the peak voltage down to a scaled voltage  $V_s$  representing a predefined percentage of this peak value. The voltage  $V_s$  is based upon the percentage drop in output voltage of the peak detector as it reflects the transition from the "high" reflectance value resulting from the scanning of the unprinted edge portions of a currency bill to the relatively lower "gray" reflectance value

resulting when the thin borderline is encountered. Preferably, the scaled voltage  $V_s$  is set to be about 70 - 80 percent of the peak voltage.

The scaled voltage  $V_s$  is supplied to a line detector 56 which is also provided with the incoming instantaneous output of the photodetector 26. The line detector 56 compares the two voltages at its input side and generates a signal  $L_{DET}$  which normally stays "low" and goes "high" when the edge of the bill is scanned. The signal  $L_{DET}$  goes "low" when the incoming photodetector output reaches the pre-defined percentage of the peak photodetector output up to that point, as represented by the voltage  $V_s$ . Thus, when the signal  $L_{DET}$  goes "low", it is an indication that the borderline of the bill pattern has been detected. At this point, the CPU 30 initiates the actual reflectance sampling under control of the encoder 32 (see FIG. 2) and the desired fixed number of reflectance samples are obtained as the currency bill moves across the illuminated light strip and is scanned along the central section of its narrow dimension.

When master characteristic patterns are being generated, the reflectance samples resulting from the scanning of a standard bill are loaded into corresponding designated sections within a system memory 60, which is preferably an EPROM. The loading of samples is accomplished through a buffered address latch 58, if necessary. Preferably, master patterns are generated by scanning a standard bill a plurality of times, typically three (3) times, and obtaining the average of corresponding data samples before storing the average as representing a master pattern. During currency discrimination, the reflectance values resulting from the scanning of a test bill are sequentially compared, under control of the correlation program stored within the memory unit 38, with each of the



corresponding characteristic patterns stored within the EPROM 60, again through the address latch 58.

Referring now to FIGS. 3-7, there are shown flow charts illustrating the sequence of operations involved in implementing the above-described optical sensing and correlation technique of this invention. FIG. 3, in particular, illustrates the sequence involved in detecting the presence of a bill under the scanhead and the borderline on the bill. This section of the system program, designated as "TRIGGER", is initiated at step 70. At step 71 a determination is made as to whether or not a start-of-note interrupt, which signifies that the system is ready to search for the presence of a bill, is set, i.e., has occurred. If the answer at step 71 is found to be positive, step 72 is reached where the presence of the bill adjacent the scanhead is ascertained on the basis of the reset procedure described above in connection with the reset unit 44 of FIG. 2.

If the answer at step 72 is found to be positive, i.e., a bill is found to be present, step 73 is reached where a test is performed to see if the borderline has been detected on the basis of the reduction in peak value to a predefined percentage thereof, which, as described above, is indicated by the signal  $L_{DER}$  going "low." If the answer at step 73 is found to be negative, the program continues to loop until the borderline has been detected. If the answer at step 72 is found to be negative, i.e., no bill is found to be present, the start-of-note interrupt is reset at step 74 and the program returns from interrupt at step 75.

If the borderline is found to have been detected at step 73, step 76 is accessed where an A/D completion interrupt is enabled, thereby signifying that the analog-to-digital conversion can subsequently be performed at desired time

intervals. Next, at step 77, the time when the first reflectance sample is to be obtained is defined, in conjunction with the output of the optical encoder. At step 78 the capture and digitization of the detected reflectance samples is undertaken by recalling a routine designated as "STARTA2D" which will be described in detail below. At the completion of the digitization process, an end-of-note interrupt must occur, which resets the system for sensing the presence of the following bill to be scanned, which is enabled at step 79. Subsequently, at step 80 the program returns from interrupt.

If the start-of-note interrupt is not found to have occurred at step 71, a determination is made at step 81 to see if the end-of-note interrupt has occurred. If the answer at 81 is negative, the program returns from interrupt at step 85. If a positive answer is obtained at 81, step 83 is accessed where the start-of-note interrupt is activated and, at step 84, the reset unit, which monitors the presence of a bill, is reset to be ready for determining the presence of bills. Subsequently, the program returns from interrupt at step 85.

Referring now to FIGS. 4A and 4B there are shown, respectively, routines for starting the STARTA2D routine and the digitizing routine itself. In FIG. 4A, the initiation of the STARTA2D routine at step 90 causes the sample pointer, which provides an indication of the sample being obtained and digitized at a given time, to be initialized. Subsequently, at step 91, the particular channel on which the analog-to-digital conversion is to be performed is enabled. The interrupt authorizing the digitization of the first sample is enabled at step 92 and the main program accessed again at step 93.

FIG. 4B is a flow chart illustrating the sequential procedure involved in the analog-to-digital conversion routine, which is designated as "A2D". The routine is started at step 100. Next, the sample pointer is decremented at step 101 so as to maintain an indication of the number of samples remaining to be obtained. At step 102, the digital data corresponding to the output of the photodetector for the current sample is read. The data is converted to its final form at step 103 and stored within a pre-defined memory segment as  $X_N$ .

Next, at step 105, a check is made to see if the desired fixed number of samples "N" has been taken. If the answer is found to be negative, step 106 is accessed where the interrupt authorizing the digitization of the succeeding sample is enabled and the program returns from interrupt at step 107 for completing the rest of the digitizing process. However, if the answer at step 105 is found to be positive, i.e., the desired number of samples have already been obtained, a flag indicating the same is set at step 108 and the program returns from interrupt at step 109.

Referring now to FIG. 5, there is shown the sequential procedure involved in executing the routine, designated as "EXEC", which performs the mathematical steps involved in the correlation process. The routine is started at step 110. At step 111, all interrupts are disabled while CPU initialization occurs. At step 112, any constants associated with the sampling process are set and, at step 113, communications protocols, if any, for exchange of processed data and associated results, bad rates, interrupt masks, etc. are defined.

At step 114, the reset unit indicating the presence of a bill is reset for detecting the presence of the first bill to be scanned. At step 115, the start-of-

note interrupt is enabled to put the system on the look out for the first incoming bill. Subsequently, at step 116, all other related interrupts are also enabled since, at this point, the initialization process has been completed and the system is ready to begin scanning bills. A check is made at step 117 to see if, in fact, all the desired number of samples have been obtained. If the answer at step 117 is found to be negative the program loops until a positive answer is obtained.

In accordance with this invention, a simple correlation procedure is utilized for processing digitized reflectance values into a form which is conveniently and accurately compared to corresponding values pre-stored in an identical format. More specifically, as a first step, the mean value  $\bar{X}$  for the set of digitized reflectance samples (comparing "n" samples) obtained for a bill scan run is first obtained as below:

$$\bar{X} = \sum_{i=0}^n \frac{X_i}{n} \quad (1)$$

Subsequently, a normalizing factor Sigma " $\sigma$ " is determined as being equivalent to the sum of the square of the difference between each sample and the mean, as normalized by the total number  $n$  of samples. More specifically, the normalizing factor is calculated as below:

$$\sigma = \sum_{i=0}^n \frac{|X_i - \bar{X}|^2}{n} \quad (2)$$

In the final step, each reflectance sample is normalized by obtaining the difference between the sample and the above-calculated mean value and dividing it by the square root of the normalizing factor Sigma " $\sigma$ " as defined by the following equation:

$$X_n = \frac{X_i - \bar{X}}{(\sigma)^{1/2}} \quad (3)$$

5

The result of using the above correlation equations is that, subsequent to the normalizing process, a relationship of correlation exists between a test pattern and a master pattern such that the aggregate sum of the products of corresponding samples in a test pattern and any master pattern, when divided by the total number of samples, equals unity if the patterns are identical. Otherwise, a value less than unity is obtained. Accordingly, the correlation number or factor resulting from the comparison of normalized samples within a test pattern to those of a stored master pattern provides a clear indication of the degree of similarity or correlation between the two patterns.

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According to a preferred embodiment of this invention, the fixed number of reflectance samples which are digitized and normalized for a bill scan is selected to be 64. It has experimentally been found that the use of higher binary orders of samples (such as 128, 256, etc.) does not provide a correspondingly increased discrimination efficiency relative to the increased processing time involved in implementing the above-described correlation procedure. It has also been found that the use of a binary order of samples lower than 64, such as 32, produces a substantial drop in discrimination efficiency.

The correlation factor can be represented conveniently in binary terms for ease of correlation. In a preferred embodiment, for instance, the factor of unity which results when a hundred percent correlation exists is represented in terms of the binary number  $2^{10}$ , which is equal to a decimal value of 1024. Using the  
5 above procedure, the normalized samples within a test pattern are compared to each of the 16 master characteristic patterns stored within the system memory in order to determine the particular stored pattern to which the test pattern corresponds most closely by identifying the comparison which yields a correlation number closest to 1024.

10 According to a feature of this invention, a bi-level threshold of correlation is required to be satisfied before a particular call is made, for at least certain denominations of bills. More specifically, the correlation procedure is adapted to identify the two highest correlation numbers resulting from the comparison of the test pattern to one of the stored patterns. At that point, a minimum threshold of  
15 correlation is required to be satisfied by these two correlation numbers. It has experimentally been found that a correlation number of about 850 serves as a good cut-off threshold above which positive calls may be made with a high degree of confidence and below which the designation of a test pattern as corresponding to any of the stored patterns is uncertain. As a second thresholding level, a  
20 minimum separation is prescribed between the two highest correlation numbers before making a call. This ensures that a positive call is made only when a test pattern does not correspond, within a given range of correlation, to more than one stored master pattern. Preferably, the minimum separation between correlation numbers is set to be 150 when the highest correlation number is

between 800 and 850. When the highest correlation number is below 800, no call is made.

Returning now to FIG. 5, the correlation procedure is initiated at step 119 where a routine designated as "PROCESS" is accessed. The procedure involved in executing this routine is illustrated at FIG. 6A which shows the routine starting at step 130. At step 131, the mean  $\bar{X}$  is calculated on the basis of Equation (1). At step 132 the sum of the squares is calculated in accordance with Equation (2). At step 133, the digitized values of the reflectance samples, as represented in integer format  $XIN$ , are converted to floating point format  $XFLOAT$  for further processing. At step 134, a check is made to see if all samples have been processed and if the answer is found to be positive, the routine ends at step 135 and the main program is accessed again. If the answer at step 134 is found to be negative, the routine returns to step 132 where the above calculations are repeated.

At the end of the routine PROCESS, the program returns to the routine EXEC at step 120 where the flag indicating that all digitized reflectance samples have been processed is reset. Subsequently, at step 121, a routine designated as "SIGCAL" is accessed. The procedure involved in executing this routine is illustrated at FIG. 6B which shows the routine starting at step 140. At step 141, the square root of the sum of the squares, as calculated by the routine PROCESS, is calculated in accordance with Equation (2). At step 142, the floating point values calculated by the routine PROCESS are normalized in accordance with Equation (3) using the calculated values at step 141. At step 143, a check is made to see if all digital samples have been processed. If the

answer at step 143 is found to be negative, the program returns to step 142 and the conversion is continued until all samples have been processed. At that point, the answer at step 143 is positive and the routine returns to the main program at step 144.

5           Returning to the flow chart of FIG. 5, the next step to be executed is step 122 where a routine designated as "CORREL" is accessed. The procedure involved in executing this routine is illustrated at FIG. 7 which shows the routine starting at 150. At step 151, correlation results are initialized to zero and, at step 152, the test pattern is compared to the first one of the stored master patterns.  
10           At step 153, the first call corresponding to the highest correlation number obtained up to that point is determined. At step 154, the second call corresponding to the second highest correlation number obtained up to that point is determined. At step 155, a check is made to see if the test pattern has been compared to all master patterns. If the answer is found to be negative, the  
15           routine reverts to step 152 where the comparison procedure is reiterated. When all master patterns have been compared to the test pattern, step 155 yields a positive result and the routine returns to the main program at step 156.

          Returning again to FIG. 5, step 124 is accessed where a routine designated as "SEROUT" is initiated. The procedure involved in executing the routine  
20           SEROUT is illustrated at FIG. 8 which shows the routine as starting at step 160. Step 161 determines whether the correlation number is greater than 799. If the answer is negative, the correlation number is too low to identify the denomination of the bill with certainty, and thus step 162 generates a "no call" code and returns to the main program at step 163.



An affirmative answer at step 161 advances the system to step 164, which determines whether the correlation number is greater than 849. An affirmative answer at step 164 indicates that the correlation number is sufficiently high that the denomination of the scanned bill can be identified with certainty without any further checking. Consequently, a "denomination" code identifying the denomination represented by the stored pattern resulting in the highest correlation number is generated at step 165, and the system returns to the main program at step 163.

A negative answer at step 164 indicates that the correlation number is between 800 and 850. It has been found that correlation numbers within this range are sufficient to identify \$1 and \$5 bills, but not other denominations of bills. Accordingly, a negative response at step 164 advances the system to step 166 which determines whether the difference between the two highest correlation numbers is greater than 149. If the answer is affirmative, the denomination identified by the highest correlation number is acceptable, and thus the "denomination" code is generated at step 165.

If the difference between the two highest correlation numbers is less than 150, step 166 produces a negative response which advances the system to step 167 to determine whether the highest correlation number identified the bill as either a \$1-bill or a \$5-bill. If the answer is affirmative, the highest correlation number is acceptable as identifying the bill denomination, and thus the "denomination" code is generated at step 165. A negative response at step 167 indicates that the bill was not identified as a \$1-bill or a \$5-bill by the highest correlation number, the difference between the two highest correlation numbers was less than 150,

and the highest correlation number was less than 850. This combination of conditions indicates that a positive call cannot be made with a high degree of confidence, and thus the "no call" code is generated at step 162.

One problem encountered in currency recognition and counting systems of the above-described kind is the difficulty involved in interrupting (for a variety of reasons) and resuming the scanning and counting procedure as a stack of bills is being scanned. If a particular currency recognition unit (CRU) has to be halted in operation due to a "major" system error, such as a bill being jammed along the transport path, there is generally no concern about the outstanding transitional status of the overall recognition and counting process. However, where the CRU has to be halted due to a "minor" error, such as the identification of a scanned bill as being a counterfeit (based on a variety of monitored parameters which are not pertinent to the present disclosure) or a "no call" (a bill which is not identifiable as belonging to a specific currency denomination based on the plurality of stored master patterns and/or other criteria), it is desirable that the transitional status of the overall recognition and counting process be retained so that the CRU may be restarted without any effective disruptions of the recognition/counting process.

More specifically, once a scanned bill has been identified as a "no call" bill ( $B_1$ ) based on some set of predefined criteria, it is desirable that this bill  $B_1$  be transported directly to the system stacker and the CRU brought to a halt with bill  $B_1$  remaining at the top-most stacker position while, at the same time, ensuring that the following bills are maintained in positions along the bill transport path

whereby CRU operation can be conveniently resumed without any disruption of the recognition/counting process.

5 Since the bill processing speeds at which currency recognition systems must operate are substantially high (speeds of the order of about 1000 bills per minute are desirable), it is practically impossible to totally halt the system following a "no call" without the following bill  $B_2$  already being transported under the optical scanhead and partially scanned. As a result, it is virtually impossible for the CRU system to retain the transitional status of the recognition/counting process (particularly with respect to bill  $B_2$ ) in order that the process may be resumed  
10 once the bad bill  $B_1$  has been transported to the stacker, conveniently removed therefrom, and the system restarted. The basic problem is that if the CRU is halted with bill  $B_2$  only partially scanned, there is no possibility of referencing the data reflectance samples extracted therefrom in such a way that the scanning may be later continued (when the CRU is restarted) from exactly the same point  
15 where the sample extraction process was interrupted when the CRU was stopped.

Even if an attempt were made at immediately halting the CRU system following a "no call," any subsequent scanning of bills would be totally unreliable because of mechanical backlash effects and the resultant disruption of the optical encoder routine used for bill scanning. Consequently, when the CRU is restarted,  
20 the call for the following bill is also likely to be bad and the overall recognition/counting process is totally disrupted as a result of an endless loop of "no calls."

According to an important feature of the present invention, the above problems are solved by an improved currency detecting and counting technique

whereby a scanned bill identified as a "no call" is transported directly to the top of the system stacker and the CRU is halted without adversely affecting the data collection and processing steps for a succeeding bill. Accordingly, when the CRU is restarted, the overall bill recognition and counting procedure can be resumed without any disruption as if the CRU had never been halted at all.

According to the improved currency detecting/counting technique, the CRU is operated in the normal fashion described above in detail, whereby an incoming bill is scanned and processed in order to make a call as to the bill denomination. If the bill is identified as a "no call" based on any of a variety of conventionally defined bill criteria (such as the criteria in FIG. 8), the CRU is subjected to a controlled deceleration process whereby the CRU operating speed, i.e., the speed at which test bills are moved across the system scanhead along the bill transport path, is reduced from its normal operating level. During this deceleration process the "no call" bill ( $B_1$ ) is transported to the top of the stacker and, at the same time, the following bill  $B_2$  is subjected to the standard scan and processing procedure in order to identify the denomination thereof.

The rate of deceleration is such that optical scanning of bill  $B_2$  is completed by the time the CRU operating speed is reduced to a predefined operating speed. While the exact operating speed at the end of the scanning of bill  $B_2$  is not critical, the objective is to permit complete scanning of bill  $B_2$  without subjecting it to backlash effects that would result if the ramping were too fast while, at the same time, ensuring that the bill  $B_1$  has in fact been transported to the stacker in the meantime.

It has experimentally been determined that at nominal operating speeds of the order of 1000 bills per minute, the deceleration is preferably such that the CRU operating speed is reduced to about one-third of its normal operating speed at the end of the deceleration phase, i.e., by the time optical scanning of bill  $B_2$  has been completed. It has been determined that at these speed levels, positive calls can be made as to the denomination of bill  $B_2$  based on reflectance samples gathered during the deceleration phase with a relatively high degree of certainty (i.e., with a correlation number exceeding about 350.)

Once the optical scanning of bill  $B_2$  has been completed, the speed is reduced to an even slower speed until the bill  $B_2$  has passed bill-edge sensors S1 and S2 described below whereby it is then brought to a complete stop. At the same time, the results of the processing of scanned data corresponding to bill  $B_2$  are stored in system memory. The ultimate result of this stopping procedure is that the CRU is brought to a complete halt following the point where the scanning of bill  $B_2$  has been reliably completed since the scan procedure is not subjected to the disruptive effects (backlash, etc.) which would result if a complete halt were attempted immediately after bill  $B_1$  is identified as a "no call."

More importantly, the reduced operating speed of the machine at the end of the deceleration phase is such that the CRU can be brought to a total halt before the next following bill  $B_3$  has been transported over the optical scanhead. Thus, when the CRU is in fact halted, bill  $B_1$  is positioned at the top of the system stacker, bill  $B_2$  is maintained in transit between the optical scanhead and the stacker after it has been subjected to scanning, and the following bill  $B_3$  is stopped short of the optical scanhead.

When the CRU is restarted, presumably after corrective action has been taken responsive to the "minor" error which led to the CRU being stopped (such as the removal of the "no call" bill from the top of the stacker), the overall bill recognition/counting operation can be resumed in an uninterrupted fashion by using the stored call results for bill  $B_2$  as the basis for updating the system count appropriately, moving bill  $B_2$  from its earlier transitional position along the transport path into the stacker, and moving bill  $B_3$  along the transport path into the optical scanhead area where it can be subjected to normal scanning and processing. A routine for executing the deceleration/stopping procedure described above is illustrated by the flow chart in FIG. 8A. This routine is initiated at step 170 with the CRU in its normal operating mode. At step 171, a test bill  $B_1$  is scanned and the data reflectance samples resulting therefrom are processed. Next, at step 172, a determination is made as to whether or not test bill  $B_1$  is a "no call" using predefined criteria in combination with the overall bill recognition procedure, such as the routine of FIG. 8. If the answer at step 172 is negative, i.e., the test bill  $B_1$  can be identified, step 173 is accessed where normal bill processing is continued in accordance with the procedures described above. If, however, the test bill  $B_1$  is found to be bad at step 172, step 174 is accessed where CRU slowdown is initiated, e.g., the transport drive motor speed is reduced to about one-third its normal speed.

Subsequently, the bad bill  $B_1$  is guided to the stacker while, at the same time, the following test bill  $B_2$  is brought under the optical scanhead and subjected to the scanning and processing steps. The call resulting from the scanning and processing of bill  $B_2$  is stored in system memory at this point. Step

175 determines whether the scanning of bill  $B_2$  is complete. When the answer is negative, step 176 determines whether a preselected "bill timeout" period has expired so that the system does not wait for the scanning of a bill that is not present. An affirmative answer at step 176 returns the system to the main  
5 program at step 175 while a negative answer at step 176 causes steps 175 and 176 to be reiterated until one of them produces an affirmative response.

An affirmative response at step 175 causes step 177 to further reduce the speed of the transport drive motor, i.e., to one-sixth the normal speed. Before stopping the transport drive motor, step 178 determines whether either of the  
10 sensors S1 or S2 (described below) is covered by a bill. A negative answer at step 178 indicates that the bill has cleared both sensors S1 and S2, and thus the transport drive motor is stopped at step 179. This signifies the end of the deceleration/stopping process. At this point in time, bill  $B_2$  remains in transit while the following bill  $B_3$  is stopped on the transport path just short of the  
15 optical scanhead.

Following step 179, corrective action responsive to the identification of a "no call" bill is conveniently undertaken; the top-most bill in the stacker is easily removed therefrom and the CRU is then in condition for resuming the recognition/counting process. Accordingly, the CRU can be restarted and the  
20 stored results corresponding to bill  $B_2$ , are used to appropriately update the system count. Next, the identified bill  $B_2$  is guided along the transport path to the stacker, and the CRU continues with its normal processing routine.

Referring now to FIGS. 9A-C there are shown three test patterns generated, respectively, for the forward scanning of a \$1 bill along its green side,

the reverse scanning of a \$2 bill on its green side, and the forward scanning of a \$100 bill on its green side. It should be noted that, for purposes of clarity the test patterns in FIGS. 9A-C were generated by using 128 reflectance samples per bill scan, as opposed to the preferred use of only 64 samples. The marked difference existing between corresponding samples for these three test patterns is indicative of the high degree of confidence with which currency denominations may be called using the foregoing optical sensing and correlation procedure.

The optical sensing and correlation technique described above permits identification of pre-programmed currency denominations with a high degree of accuracy and is based upon a relatively low processing time for digitizing sampled reflectance values and comparing them to the master characteristic patterns. The approach is used to scan currency bills, normalize the scanned data and generate master patterns in such a way that bill scans during operation have a direct correspondence between compared sample points in portions of the bills which possess the most distinguishable printed indicia. A relatively low number of reflectance samples is required in order to be able to adequately distinguish between several currency denominations.

A major advantage with this approach is that it is not required that currency bills be scanned along their wide dimensions. Further, the reduction in the number of samples reduces the processing time to such an extent that additional comparisons can be made during the time available between the scanning of successive bills. More specifically, as described above, it becomes possible to compare a test pattern with two or more stored master characteristic



patterns so that the system is made capable of identifying currency which is scanned in the "forward" or "reverse" directions along the green surface of the bill.

Another advantage accruing from the reduction in processing time realized by the present sensing and correlation scheme is that the response time involved in either stopping the transport of a bill that has been identified as "spurious", i.e., not corresponding to any of the stored master characteristic patterns, or diverting such a bill to a separate stacker bin, is correspondingly shortened. Accordingly, the system can conveniently be programmed to set a flag when a scanned pattern does not correspond to any of the master patterns. The identification of such a condition can be used to stop the bill transport drive motor for the mechanism. Since the optical encoder is tied to the rotational movement of the drive motor, synchronism can be maintained between pre- and post-stop conditions. In the dual-processor implementation discussed above, the information concerning the identification of a "spurious" bill would be included in the information relayed to the general processor unit which, in turn, would control the drive motor appropriately.

The correlation procedure and the accuracy with which a denomination is identified directly relates to the degree of correspondence between reflectance samples on the test pattern and corresponding samples on the stored master patterns. Thus, shrinkage of "used" bills which, in turn, causes corresponding reductions in their narrow dimensions, can possibly produce a drop in the degree of correlation between such used bills of a given denomination and the corresponding master patterns. Currency bills which have experienced a high

degree of usage exhibit such a reduction in both the narrow and wide dimensions of the bills. While the sensing and correlation technique of this invention remains relatively independent of any changes in the wide dimension of bills, reduction along the narrow dimension can affect correlation factors by realizing a relative displacement of reflectance samples obtained as the "shrunk" bills are transported across the scanhead.

In order to accommodate or nullify the effect of such narrow dimension shrinking, the above-described correlation technique can be modified by use of a progressive shifting approach whereby a test pattern which does not correspond to any of the master patterns is partitioned into predefined sections, and samples in successive sections are progressively shifted and compared again to the stored patterns in order to identify the denomination. It has experimentally been determined that such progressive shifting effectively counteracts any sample displacement resulting from shrinkage of a bill along its narrow dimension.

The progressive shifting effect is best illustrated by the correlation patterns shown in FIGS. 10A-D. For purposes of clarity, the illustrated patterns were generated using 128 samples for each bill scan as compared to the preferred use of 64 samples. FIG. 10A shows the correlation between a test pattern (represented by a heavy line) and a corresponding master pattern (represented by a thin line). It is clear from FIG. 10A that the degree of correlation between the two patterns is relatively low and exhibits a correlation factor of 606.

The manner in which the correlation between these patterns is increased by employing progressive shifting is best illustrated by considering the correlation at the reference points designated as A-E along the axis defining the number of

samples. The effect on correlation produced by "single" progressive shifting is shown in FIG. 10B which shows "single" shifting of the test pattern of FIG. 10A. This is effected by dividing the test pattern into two equal segments each comprising 64 samples. The first segment is retained without any shift, whereas  
5 the second segment is shifted by a factor of one data sample. Under these conditions, it is found that the correlation factor at the reference points located in the shifted section, particularly at point E, is improved.

FIG. 10C shows the effect produced by "double" progressive shifting whereby sections of the test pattern are shifted in three stages. This is  
10 accomplished by dividing the overall pattern into three approximately equal sized sections. Section one is not shifted, section two is shifted by one data sample (as in FIG. 10B), and section three is shifted by a factor of two data samples. With "double" shifting, it can be seen that the correlation factor at point E is further increased.

15 On a similar basis, FIG. 10D shows the effect on correlation produced by "triple" progressive shifting where the overall pattern is first divided into four (4) approximately equal sized sections. Subsequently, section one is retained without any shift, section two is shifted by one data sample, section three is shifted by two data samples, and section four is shifted by three data samples. Under these  
20 conditions, the correlation factor at point E is seen to have increased again.

FIG. 10E shows the effect on correlation produced by "quadruple" shifting, where the pattern is first divided into five (5) approximately equal sized sections. The first four (4) sections are shifted in accordance with the "triple" shifting approach of FIG. 10D, whereas the fifth section is shifted by a factor of four (4)

data samples. From FIG. 10E it is clear that the correlation at point E is increased almost to the point of superimposition of the compared data samples.

5 The advantage of using the progressive shifting approach, as opposed to merely shifting by a set amount of data samples across the overall test pattern, is that the improvement in correlation achieved in the initial sections of the pattern as a result of shifting is not neutralized or offset by any subsequent shifts in the test pattern. It is apparent from the above figures that the degree of correlation for sample points falling within the progressively shifted sections increases correspondingly.

10 More importantly, the progressive shifting realizes substantial increases in the overall correlation factor resulting from pattern comparison. For instance, the original correlation factor of 606 (FIG. 10A) is increased to 681 by the "single" shifting shown in FIG. 10B. The "double" shifting shown in FIG. 10C increases the correlation number to 793, the "triple" shifting of FIG. 10D  
15 increases the correlation number to 906, and, finally, the "quadruple" shifting shown in FIG. 10E increases the overall correlation number to 960. Using the above approach, it has been determined that used currency bills which exhibit a high degree of narrow dimension shrinkage and which cannot be accurately identified as belonging to the correct currency denomination when the correlation  
20 is performed without any shifting, can be identified with a high degree of certainty by using progressive shifting approach, preferably by adopting "triple" or "quadruple" shifting.

Referring now to FIG. 11, there is shown apparatus 210 for currency discrimination and counting which embodies the principles of the present

invention. The apparatus comprises a housing 212 which includes left and right hand sidewalls 214 and 216, respectively, a rear wall 218, and a top surface generally designated as 220. The apparatus has a front section 222 which comprises a generally vertical forward section 224 and a forward sloping section 225 which includes side sections provided with control panels 226A and 226B upon which various control switches for operating the apparatus, as well as associated display means, are mounted.

For accepting a stack of currency bills 228 (FIG. 12) which have to be discriminated according to denomination, an input bin 227 is defined on the top surface 220 by a downwardly sloping support surface 229 on which are provided a pair of vertically disposed side walls 230, 232 linked together by a vertically disposed front wall 234. The walls 230, 232 and 234, in combination with the sloping surface 229, define an enclosure where the stack of currency bills 228 is positioned.

From the input bin, currency bills are moved along a tri-sectional transport path which includes an input path where bills are moved along a first direction in a substantially flat position, a curved guideway where bills are accepted from the input path and guided in such a way as to change the direction of travel to a second different direction, and an output path where the bills are moved in a flat position along the second different direction across currency discrimination means located downstream of the curved guideway, as will be described in detail below. In accordance with the improved optical sensing and correlation technique of this invention, the transport path is defined in such a way that currency bills are accepted, transported along the input path, the curved guideway, and the output

path, and stacked with the narrow dimension "W" of the bills being maintained parallel to the transport path and the direction of movement at all times.

The forward sloping section 225 of the document handling apparatus 210 includes a platform surface 235 centrally disposed between the side walls 214, 216 and is adapted to accept currency bills which have been processed through the currency discrimination means for delivery to a stacker plate 242 where the processed bills are stacked for subsequent removal. More specifically, the platform 235 includes an associated angular surface 236 and is provided with openings 237, 237A from which flexible blades 238A, 240A of a corresponding pair of stacker wheels 238, 240, respectively, extend outwardly. The stacker wheels are supported for rotational movement about a stacker shaft 241 disposed about the angular surface 236 and suspended across the side walls 214 and 216. The flexible blades 238A, 240A of the stacker wheels cooperate with the stacker platform 235 and the openings 237, 237A to pick up currency bills delivered thereto. The blades operate to subsequently deliver such bills to a stacker plate 242 which is linked to the angular surface 236 and which also accommodates the stacker wheel openings and the wheels projecting therefrom. During operation, a currency bill which is delivered to the stacker platform 235 is picked up by the flexible blades and becomes lodged between a pair of adjacent blades which, in combination, define a curved enclosure which decelerates a bill entering therein and serves as a means for supporting and transferring the bill from the stacker platform 235 onto the stacker plate 242 as the stacker wheels rotate. The mechanical configuration of the stacker wheels and the flexible blades provided thereupon, as well as the manner in which they cooperate with the stacker

platform and the stacker plate, is conventional and, accordingly, is not described in detail herein.

5 The bill handling and counting apparatus 210 is provided with means for picking up or "stripping" currency bills, one at a time, from bills that are stacked in the input bin 227. In order to provide this stripping action, a feed roller 246 is rotationally suspended about a drive shaft 247 which, in turn, is supported across the side walls 214, 216. The feed roller 246 projects through a slot provided on the downwardly sloping surface 229 of the input bin 227 which defines the input path and is in the form of an eccentric roller at least a part of the periphery of which is provided with a relatively high friction-bearing surface 246A. The surface 246A is adapted to engage the bottom bill of the bill stack 228 as the roller 246 rotates; this initiates the advancement of the bottom bill along the feed direction represented by the arrow 247B (see FIG. 13). The eccentric surface of the feed roller 246 essentially "jogs" the bill stack once per revolution so as to  
10  
15 agitate and loosen the bottom currency bill within the stack, thereby facilitating the advancement of the bottom bill along the feed direction.

The action of the feed roller 246 is supplemented by the provision of a capstan or drum 248 which is suspended for rotational movement about a capstan drive shaft 249 which, in turn, is supported across the side walls 214 and 216. Preferably, the capstan 248 comprises a centrally disposed friction roller 248A having a smooth surface and formed of a friction-bearing material such as rubber or hard plastic. The friction roller is sandwiched between a pair of capstan rollers 248B and 248C, at least a part of the external peripheries of which are provided with a high friction-bearing surface 248D.  
20

The friction surface 248D is akin to the friction surface 246A provided on the feed roller and permits the capstan rollers to frictionally advance the bottom bill along the feed direction. Preferably, the rotational movement of the capstan 248 and the feed roller 246 is synchronized in such a way that the frictional surfaces provided on the peripheries of the capstan and the feed roller rotate in unison, thereby inducing complimentary frictional contact with the bottom bill of the bill stack 228.

In order to ensure active contact between the capstan 248 and a currency bill which is jogged by the feed roller 246 and is in the process of being advanced frictionally by the capstan rollers 248B, 248C, a pair of picker rollers 252A, 252B, are provided for exerting a consistent downward force onto the leading edges of the currency bills stationed in the input bin 227. The picker rollers are supported on corresponding picker arms 254A, 254B which, in turn, are supported for arcuate movement about a support shaft 256 suspended across the side walls of the apparatus. The picker rollers are free wheeling about the picker arms and when there are no currency bills in contact with the capstan 248, bear down upon the friction roller 248A and, accordingly, are induced into counter-rotation therewith. However, when currency bills are present and are in contact with the capstan 248, the picker rollers bear down into contact with the leading edges of the currency bills and exert a direct downward force on the bills since the rotational movement of rollers is inhibited. The result is that the advancing action brought about by contact between the friction-bearing surfaces 248D on the capstan rollers 248B, 248C is accentuated, thereby facilitating the stripping away of a single currency bill at a time from the bill stack 228.



In between the picker arms 254A, 254B, the support shaft 256 also supports a separator arm 260 which carries at its end remote from the shaft a stationary stripper shoe 258 which is provided with a frictional surface which imparts a frictional drag upon bills onto which the picker rollers bear down. The  
5 separator arm is mounted for arcuate movement about the support shaft 256 and is spring loaded in such a way as to bear down with a selected amount of force onto the capstan.

In operation, the picker rollers rotate with the rotational movement of the friction roller 248A due to their free wheeling nature until the leading edges of  
10 one or more currency bills are encountered. At that point, the rotational movement of the picker rollers stops and the leading edges of the bills are forced into positive contact with the friction bearing surfaces on the periphery of the capstan rollers. The effect is to force the bottom bill away from the rest of the bills along the direction of rotation of the capstan. At the same time, the  
15 separator shoe 258 also bears down on any of the bills that are propelled forward by the capstan rollers.

The tension on the picker arm 254A is selected to be such that the downward force exerted upon such a propelled bill allows only a single bill to move forward. If two or more bills happen to be propelled out of the contact  
20 established between the picker rollers and the capstan rollers, the downward force exerted by the spring loaded shoe should be sufficient to inhibit further forward movement of the bills. The tension under which the picker arm is spring loaded can be conveniently adjusted to control the downward bearing force exerted by the shoe in such a way as to compliment the bill stripping action

produced by the picker rollers and the capstan rollers. Thus, the possibility that more than two bills may be propelled forward at the same time due to the rotational movement of the capstan is significantly reduced.

5 The bill transport path includes a curved guideway 270 provided in front of the capstan 248 for accepting currency bills that have been propelled forward along the input path defined by the forward section of the sloping surface 229 into frictional contact with the rotating capstan. The guideway 270 includes a curved section 272 which corresponds substantially to the curved periphery of the capstan 248 so as to compliment the impetus provided by the capstan rollers  
10 248B, 248C to a stripped currency bill.

A pair of idler rollers 262A, 262B is provided downstream of the picker rollers for guiding bills propelled by the capstan 248 into the curved guideway 270. More specifically, the idler rollers are mounted on corresponding idler arms 264A, 264B which are mounted for arcuate movement about an idler shaft 266  
15 which, in turn, is supported across the side walls of the apparatus. The idler arms are spring loaded on the idler shaft so that a selected downward force can be exerted through the idler rollers onto a stripped bill, thereby ensuring continued contact between the bill and the capstan 248 until the bill is guided into the curved section 272 of the guideway 270.

20 A modified feed mechanism is described in the assignee's copending United States patent application Serial No. 07/680,585, filed April 4, 1991, for "Feed Arrangement For Currency Handling Machines," which is incorporated herein by reference.

Downstream of the curved section 272, the bill transport path has an output path for currency bills. The output path is provided in the form of a flat section 274 along which bills which have been guided along the curved guideway 270 by the idler rollers 262A, 262B are moved along a direction which is opposite to the direction along which bills are moved out of the input bin. The movement of bills along the direction of rotation of the capstan, as induced by the picker rollers 252A, 252B and the capstan rollers 248B, 248C, and the guidance provided by the section 272 of the curved guideway 270 changes the direction of movement of the currency bills from the initial movement along the sloping surface 229 of input bin 227 (see arrow 247B in FIG. 13) to a direction along the flat section 274 of the output path, as best illustrated in FIG. 13 by the arrow 272B.

Thus, a currency bill which is stripped from the bill stack in the input bin is initially moved along the input path under positive contact between the picker rollers 252A, 252B and the capstan rollers 248B, 248C. Subsequently, the bill is guided through the curved guideway 270 under positive contact with the idler rollers 262A, 262B onto the flat section 274 of the output path.

In the output path, currency bills are positively guided along the flat section 274 by means of a transport roller arrangement which includes a pair of axially spaced, positively driven transport rollers 301, 302 which are respectively disposed on transport shafts 303 and 304 supported across the sidewalls of the apparatus. The first transport roller 301 includes a pair of projecting cylindrical sections 301A, 301B which preferably have a high-friction outer surface, such as by the provision of knurling thereupon. The second transport roller 302 which is

downstream of the first roller along the flat section of the transport path also has similar cylindrical high-friction knurled sections 302A and 302B.

The flat section 274 is provided with openings through which each of the knurled sections of the transport rollers 301 and 302 are subjected to counter-rotating contact with corresponding passive transport rollers 305A, 305B, 306A and 306B. The passive rollers are mounted below the flat section 274 of the transport path in such a manner as to be freewheeling about their axes and biased into counter-rotating contact with the corresponding knurled sections of the first and second transport rollers. While any appropriate mechanical suspending and pressuring arrangement may be used for this purpose, in the illustrative embodiment passive rollers 305A and 306A are biased into contact with knurled sections 301A and 302B by means of an H-shaped leaf spring 307. The rollers are cradled in a freewheeling fashion within each of the two cradle sections of the spring through a support shaft (not shown) appropriately suspended about the spring. The arrangement is such that the leaf spring 307 is mounted relative to the passive rollers 305A and 306A in such a way that a controllable amount of pressure is exerted against the rollers and pushes them against the active rollers 301 and 302. A similar leaf spring/suspension arrangement is used to mount the other set of passive rollers 305B and 306B into spring-loaded, freewheeling counter-rotating contact with the knurled sections 301B and 302B of the active transport rollers 301 and 302.

Preferably, the points of contact between the active and passive rollers are made coplanar with the output path so that currency bills can be moved or

positively guided along the path in a flat manner under the positive contact of the opposingly disposed active and passive rollers.

5       The distance between the two active transport rollers and, of course, the corresponding counter-rotating passive rollers, is selected to be just short of the length of the narrow dimension of the currency bills that are to be discriminated. Accordingly, currency bills are firmly gripped under uniform pressure between the two sets of active and passive rollers within the scanhead area, thereby minimizing the possibility of bill skew and enhancing the reliability of the overall scanning and recognition process.

10       The first active transport roller 301 is driven at a speed substantially higher than that of the capstan rollers in the feed section. Since the passive rollers are freewheeling and the active rollers are positively driven, the first transport roller 301 causes a bill that comes between the roller and its corresponding passive rollers 305A, 305B along the flat section of the output path  
15       to be pulled into the nip formed between the active and passive rollers (more specifically, between these passive rollers and the corresponding knurled sections 301A, 301B on the active transport roller). The higher speed of the active transport roller imparts an abrupt acceleration to the bill which strips the bill away from any other bills that may have been guided into the curved guideway  
20       along with the particular bill being acted upon by the transport roller.

Currency bills are subsequently moved downstream of the first transport roller along the flat section into the nip formed between the knurled sections 302A, 302B on the second active transport roller 302 and the corresponding

passive rollers 306A, 306B with the second active transport roller being driven at the same speed as that of the first transport roller.

5 The disposition of the second transport roller is selected to be such that the positive contact exerted by the cylindrical knurled sections 302A, 302BA on the second transport roller 302 and the corresponding passive rollers 306A, 306B upon a currency bill moving along the output path occurs before the bill is released from the similar positive contact between the knurled sections 301A, 301B on the first transport roller 301 and the corresponding passive rollers 305A, 305B. As a result, the second transport roller 302 and its corresponding passive rollers 306A, 306B together positively guide a currency bill through the scanhead area (where the transport rollers are located) onto the stacker platform 235, from where the stacker wheels 238, 240 pick up the bill and deposit it onto the stacker place 242.

15 Bills are held flat against the scanhead 18 by means of a plurality of O-rings 308 which are disposed in corresponding grooves 309 on the transport rollers 301 and 302. In a preferred arrangement, five such O-rings 308A-E are used, one at each end of the transport rollers and three in the central regions of the rollers.

20 The positive guiding arrangement described above is advantageous in that uniform guiding pressure is maintained upon bills as they are transported through the optical scanhead area; more importantly, this is realized without adding significantly to mechanical complexity. In effect, the bill feeding operation is made stable, and twisting or skewing of currency bills is substantially reduced. This positive action is supplemented by the use of the H-spring for uniform

biasing the passive rollers into contact with the active rollers so that bill twisting or skew resulting from differential pressure applied to the bills along the transport path is avoided. The O-rings 308 function as simple, yet extremely effective means for ensuring that the bills are held flat. Since the O-rings  
5 constitute standard off-the shelf items, any adjustment of the center distance between the two active transport rollers can be conveniently accommodated.

Referring now in particular to FIGS. 14 and 15, there are shown side and top views, respectively, of the document processing apparatus of FIGS. 11-13, which illustrate the mechanical arrangement for driving the various means for  
10 transporting currency bills along the three sections of the transport path, i.e., along the input path, the curved guideway and the output path. As shown therein, a motor 320 is used to impart rotational movement to the capstan shaft 249 by means of a belt/pulley arrangement comprising a pulley 321 provided on the capstan shaft 249 and which is linked to a pulley 322 provided on the motor  
15 drive shaft through a belt 323. The diameter of the driver pulley 321 is selected to be appropriately larger than that of the motor pulley 322 in order to achieve the desired speed reduction from the typically high speed at which the motor 320 operates.

The drive shaft 247 for the drive roller 246 is provided with rotary motion  
20 by means of a pulley 324 provided thereupon which is linked to a corresponding pulley 321 provided on the capstan shaft 249 through a belt 326. The pulleys 324 and 321 are of the same diameter so that the drive roller shaft 247 and, hence, the drive roller 246, rotate in unison with the capstan 248 mounted on the capstan shaft 249.

In order to impart rotational movement to the transport rollers, a pulley 327 is mounted on the transport roller shaft 287 corresponding to the first set of transport rollers and is linked to a corresponding pulley 328 on the capstan shaft 249 through a belt 329. The diameter of the transport roller pulley 327 is selected to be appropriately smaller than that of the corresponding capstan pulley 328 so as to realize a stepping-up in speed from the capstan rollers to the transport rollers. The second set of transport rollers mounted on the transport roller shaft 288 is driven at the same speed as the rollers on the first set of transport rollers by means of a pulley 330 which is linked to the transport pulley 327 by means of a belt 325.

As also shown in FIGS. 14 and 15, an optical encoder 299 is mounted on one of the transport roller shafts, preferably the passively driven transport shaft 288, for precisely tracking the lateral displacement of bills supported by the transport rollers in terms of the rotational movement of the transport shafts, as discussed in detail above in connection with the optical sensing and correlation technique of this invention.

In order to drive the stacker wheels 238 and 240, an intermediate pulley 330 is mounted on suitable support means (not shown) and is linked to a corresponding pulley 331 provided on the capstan shaft 249 through a belt 332. Because of the time required for transporting currency bills which have been stripped from the currency stack in the input bin through the tri-sectional transport path and onto the stacker platform, the speed at which the stacker wheels can rotate for delivering processed bills to the stacker plate is necessarily less than that of the capstan shaft. Accordingly, the diameter of the intermediate



pulley 333a is selected to be larger than that of the corresponding capstan pulley 331 so as to realize a reduction in speed. The intermediate pulley 333a has an associated pulley 333 which is linked to a stacker pulley 334 provided on the drive shaft 241 for the stacker wheels 238, 240 by means of a belt 335. In the preferred embodiment shown in FIGS. 11-15, the stacker wheels 238, 240 rotate in the same direction as the capstan rollers. This is accomplished by arranging the belt 335 between the pulleys 333, 334 in a "Figure-8" configuration about an anchoring pin 336 disposed between the two pulleys.

The curved section 272 of the guideway 270 is provided on its underside with an optical sensor arrangement 299, including an LED 298, for performing standard currency handling operations such as counterfeit detection using conventional techniques, doubles detection, length detection, skew detection, etc. However, unlike conventional arrangements, currency discrimination according to denomination is not performed in this area for reasons described below.

According to a feature of this invention, optical scanning of currency bills, in accordance with the above-described improved optical sensing and correlation technique, is performed by means of an optical scanhead 296 which is disposed downstream of the curved guideway 270 along the flat section 274 of the output path. More specifically, the scanhead 296 is located under the flat section of the output path between the two sets of transport rollers. The advantage of this approach is that optical scanning is performed on bills when they are maintained in a substantially flat position as a result of positive contact between the two sets of transport rollers at both ends of the bill along their narrow dimension.

It should be understood that the above-described drive arrangement is provided for illustrative purposes only. Alternate arrangements for imparting the necessary rotational movement to generate movement of currency bills along the tri-sectional transport path can be used just as effectively. It is important, however, that the surface speed of currency bills across the two sets of transport rollers be greater than the surface speed of the bills across the capstan rollers in order to achieve optimum bill separation. It is this difference in speed that generates the abrupt acceleration of currency bills as the bills come into contact with the first set of transport rollers.

The drive arrangement may also include a one-way clutch (not shown) provided on the capstan shaft and the capstan shafts, the transport roller shafts and the stacker wheel shafts may be fitted with fly-wheel arrangements (not shown). The combination of the one-way clutch and the fly wheels can be used to advantage in accelerated batch processing of currency bills by ensuring that any bills remaining in the transport path after currency discrimination are automatically pulled off the transport path into the stacker plate as a result of the inertial dynamics of the fly wheel arrangements.

As described above, implementation of the optical sensing and correlation technique of this invention requires only a relatively low number of reflectance samples in order to adequately distinguish between several currency denominations. Thus, highly accurate discrimination becomes possible even though currency bills are scanned along their narrow dimension. However, the accuracy with which a denomination is identified is based on the degree of correlation between reflectance samples on the test pattern and corresponding

samples on the stored master patterns. Accordingly, it is important that currency bills be transported across the discrimination means in a flat position and, more importantly, at a uniform speed.

5 This is achieved in the bill handling apparatus of FIGS. 11-15, by positioning the optical scanhead 296 on one side of the flat section 274 of the output path between the two sets of transport rollers. In this area, currency bills are maintained in positive contact with the two sets of rollers, thereby ensuring that the bills move across the scanhead in a substantially flat fashion. Further, a uniform speed of bill movement is maintained in this area because the second set of passive transport rollers is driven at a speed identical to that of the active transport rollers by means of the drive connection between the two sets of rollers. 10 Disposing the optical scanhead 296 in such a fashion downstream of the curved guideway 270 along the flat section 274 maintains a direct correspondence between reflectance samples obtained by the optically scanning of bills to be discriminated and the corresponding samples in the stored master patterns. 15

According to a preferred embodiment, the optical scanhead comprises a plurality of light sources acting in combination to uniformly illuminate light strips of the desired dimension upon currency bills positioned on the transport path below the scanhead. As illustrated in FIGS. 17-18, the scanhead 296 includes a pair of LEDs 340, 342, directing beams of light 341A and 343B, respectively, onto the flat section 274 of the output path against which the scanhead is positioned. 20 The LEDs 340, 342 are angularly disposed relative to the vertical axis Y in such a way that their respective light beams combine to illuminate the desired light strip. The scanhead 296 includes a photodetector 346 centrally disposed on an axis

normal to the illuminated strip for sensing the light reflected off the strip. The photodetector 346 is linked to a central processing unit (CPU)(not shown) for processing the sensed data in accordance with the above-described principles of this invention. Preferably, the beams of light 340A, 340B from the LEDs 340, 342, respectively, are passed through an optical mask 345 in order to realize the illuminated strips of the desired dimensions.

In order to capture reflectance samples with high accuracy, it is important that the photodetector capture reflectance data uniformly across the illuminated strip. In other words, when the photodetector 346 is positioned on an axis passing through the center of the illuminated strip, the illumination by the LED's as a function of the distance from the central point "0" along the X axis, should optimally approximate a step function as illustrated by the curve A in FIG. 19. With the use of a single light source angularly displaced relative to the vertical, the variation in illumination by an LED typically approximates a Gaussian function, as illustrated by the curve B in FIG. 19.

In accordance with a preferred embodiment, the two LEDs 340 and 342 are angularly disposed relative to the vertical axis by angles  $\alpha$  and  $\beta$ , respectively. The angles  $\alpha$  and  $\beta$  are selected to be such that the resultant strip illumination by the LED's is as close as possible to the optimum distribution curve A in FIG. 19. According to a preferred embodiment, the angles  $\alpha$  and  $\beta$  are each selected to be 19.9 degrees. The LED illumination distribution realized by this arrangement is illustrated by the curve designated as "C" in FIG. 19 which effectively merges the individual Gaussian distributions of each light source to yield a composite distribution which sufficiently approximates the optimum curve A.

The manner in which the plurality of light strips of different dimensions are generated by the optical scanhead by means of an optical mask is illustrated in FIG. 16-18. As shown therein, the optical mask 345 essentially comprises a generally opaque area in which two slits 354 and 356 are formed to allow light from the light sources to pass through so as to illuminate light strips of the desired dimensions. More specifically, slit 354 corresponds to the wide strip used for obtaining the reflectance samples which correspond to the characteristic pattern for a test bill. In a preferred embodiment, the wide slit 354 has a length of about 0.500" and a width of about 0.050". The second slit 356 forms a relatively narrow illuminated strip used for detecting the thin borderline surrounding the printed indicia on currency bills, as described above in detail. In a preferred embodiment, the narrow slit 356 has a length of about 0.300" and a width of about 0.010".

It is preferred that a separate pair of light sources 340 and 342 be provided for each of the two slits 354 and 356. Thus, as can be seen in FIGS. 17 and 18, a first pair of LED'S 340A and 342A are provided for the narrow slit, and a second pair of LED's 340B and 342B are provided for the second slit. Similarly, two separate photodetectors 346A and 346B are provided for detecting reflected light from the two slits. As can be seen in FIGS. 17 and 18, the channel for transmitting reflected light from the narrow slit to the photodetector 346A is narrower in the transverse direction than the channel for transmitting reflected light from the wide slit to the photodetector 346B.

According to another feature of the present invention, the undesired doubling or overlapping of bills in the transport system is detected by the

provision of a pair of optical sensors which are co-linearly disposed opposite to each other within the scan head area along a line that is perpendicular to the direction of bill flow, i.e., parallel to the edge of test bills along their wide dimensions as the bills are transported across the optical scan head.

5 As best illustrated in FIG. 20, the pair of optical sensors S1 and S2 (having corresponding light sources and photodetectors which are not shown here) are co-linearly disposed within the scan head area in close parallelism with the wide dimension edges of incoming test bills. In effect, the optical sensors S1 and S2 are disposed opposite each other along a line within the scan head area which is  
10 perpendicular to the direction of bill flow.

It should be noted that FIGS. 11, 13 and 15 also include an illustration of the physical disposition of the sensors S1 and S2 within the optical scanhead area of the currency recognition and counting apparatus. For purposes of clarity, the sensors S1 and S2 are represented only in the form of blocks which correspond to  
15 the light sources associated with the sensors. Although not illustrated in the drawings, it should be noted that corresponding photodetectors (not shown) are provided within the scanhead area in immediate opposition to the corresponding light sources and underneath the flat section of the transport path. These detectors detect the beam of coherent light directed downwardly onto the bill  
20 transport path from the light sources corresponding to the sensors S1 and S2 and generate an analog output which corresponds to the sensed light. Each such output is converted into a digital signal by a conventional ADC convertor unit (not shown) whose output is fed as a digital input to and processed by the system

CPU (not shown), in a manner similar to that indicated in the arrangement of FIG. 1.

5 The presence of a bill which passes under the sensors S1 and S2 causes a change in the intensity of the detected light, and the corresponding change in the analog output of the detectors serves as a convenient means for density-based measurements for detecting the presence of "doubles" (two or more overlaid or overlapped bills) during the currency recognition and counting process. For instance, the sensors may be used to collect a predefined number of density measurements on a test bill, and the average density value for a bill may be compared to predetermined density thresholds (based, for instance, on  
10 standardized density readings for master bills) to determine the presence of overlaid bills or doubles.

A routine for using the outputs of the two sensors S1 and S2 to detect any doubling or overlapping of bills is illustrated in FIG. 21. This routine starts when  
15 the denomination of a scanned bill has been determined at step 401, as described previously. To permit variations in the sensitivity of the density measurement, a "density setting choice" is retrieved from memory at step 402. The operator makes this choice manually, according to whether the bills being scanned are new bills, requiring only a high degree of sensitivity, or used bills, requiring a lower  
20 level of sensitivity. After the "density setting choice" has been retrieved, the system then proceeds through a series of steps which establish a density comparison value according to the denomination of the bill. Thus, step 403 determines whether the bill has been identified as a \$20-bill, and if the answer is affirmative, the \$20-bill density comparison value is retrieved from memory at

step 404. A negative answer at step 403 advances the system to step 405 to determine whether the bill has been identified as a \$100-bill, and if the answer is affirmative, the \$100-bill density comparison value is retrieved from memory at step 406. A negative answer at step 405 advances the system to step 407 where a  
5 general density comparison value, for all remaining bill denominations, is retrieved from memory.

At step 408, the density comparison value retrieved at step 404, 406 or 407 is compared to the average density represented by the output of sensor S1. The result of this comparison is evaluated at step 409 to determine whether the  
10 output of sensor S1 identifies a doubling of bills for the particular denomination of bill determined at step 401. If the answer is negative, the system returns to the main program. If the answer is affirmative, step 410 then compares the retrieved density comparison value to the average density represented by the output of the second sensor S2. The result of this comparison is evaluated at step 401 to  
15 determine whether the output of sensor S2 identifies a doubling of bills. Affirmative answers at both step 409 and step 411 results in the setting of a "doubles error" flag at step 412, and the system then returns to the main program. The "doubles error" flag can, of course, be used to stop the bill transport motor.

20 FIG. 22 illustrates a routine that enables the system to detect bills which have been badly defaced by dark marks such as ink blotches, felt-tip pen marks and the like. Such severe defacing of a bill can result in such distorted scan data that the data can be interpreted to indicate the wrong denomination for the bill. Consequently, it is desirable to detect such severely defaced bills and then stop



the bill transport mechanism so that the bill in question can be examined by the operator.

The routine of FIG. 22 retrieves each successive data sample at step 450 and then advances to step 451 to determine whether that sample is too dark. As described above, the output voltage from the photodetector 26 decreases as the darkness of the scanned area increases. Thus, the lower the output voltage from the photodetector, the darker the scanned area. For the evaluation carried out at step 451, a preselected threshold level for the photodetector output voltage, such as a threshold level of about 1 volt, is used to designate a sample that is "too dark."

An affirmative answer at step 451 advances the system to step 452 where a "bad sample" count is incremented by one. A single sample that is too dark is not enough to designate the bill as seriously defaced. Thus, the "bad sample" count is used to determine when a preselected number of consecutive samples, e.g., ten consecutive samples, are determined to be too dark. From step 452, the system advances to step 453 to determine whether ten consecutive bad samples have been received. If the answer is affirmative, the system advances to step 454 where an error flag is set. This represents a "no call" condition, which causes the bill transport system to be stopped in the same manner discussed above in connection with FIG. 8A.

When a negative response is obtained at step 451, the system advances to step 455 where the "bad sample" count is reset to zero, so that this count always represents the number of consecutive bad samples received. From step 455 the system advances to step 456 which determines when all the samples for a given

bill have been checked. As long as step 456 yields a negative answer, the system continues to retrieve successive samples at step 450. When an affirmative answer is produced at step 456, the system returns to the main program at step 457.

5 It is desirable to maintain a predetermined space between each pair of successive bills to facilitate the resetting of the scanning system between the trailing edge of the scanned area on one bill and the leading borderline on the next bill. The routine for performing this spacing check is illustrated in FIG. 23. This routine begins with step 500, which checks the output signals from the sensors S1 and S2 to determine when the leading edge of a bill is detected by  
10 either sensor. The detection of a predetermined change in the output from either sensor S1 or S2 advances the system to step 501, which determines whether the detected output change is from the first sensor to see the leading edge of a bill. If the answer is affirmative the system returns to the main program at step 503. A negative response at step 501 advances the system to step 504 to determine  
15 whether the spacing check is done yet. If the answer is "yes," the system returns to the main program. If the answer is "no," step 505 determines whether a spacing check is to be performed, based on whether the first bill in a new stack of bills placed in the CRU has been detected. That is, there is no need to initiate a spacing check until the first bill reaches the sensors S1 and S2. Thus, a negative  
20 answer at step 505 returns the system to the main program, while an affirmative answer advances the system to step 506 which compares the actual spacing count, i.e., the number of encoder pulses produced after detection of the leading edge of the bill, to a preselected minimum spacing count retrieved from memory. If the actual spacing count is above the preselected minimum, there is no error and

consequently the next step 507 yields a negative response, indicating that there is no spacing error. This negative response sets a "spacing error checked" flag at step 509. If the actual spacing count is below the preselected minimum, step 509 detects a spacing error and consequently produces an affirmative response which sets an error flag at step 508. The system then returns to the main program at step 503. It is this flag that is read at step 504.

A routine for automatically monitoring and making any necessary corrections in various line voltages is illustrated in FIG. 24. This routine is useful in automatically compensating for voltage drifts due to temperature changes, aging of components and the like. The routine starts at step 550 which reads the output of a line sensor which is monitoring a selected voltage. Step 551 determines whether the reading is below 0.60, and if the answer is affirmative, step 552 determines whether the reading is above 0.40. If step 552 also produces an affirmative response, the voltage is within the required range and thus the system returns to the main program step 553. If step 551 produces a negative response, an incremental correction is made at step 554 to reduce the voltage in an attempt to return it to the desired range. Similarly, if a negative response is obtained at step 552, an incremental correction is made at step 555 to increase the voltage toward the desired range.

## CLAIMS:

1. A currency counting and evaluation device for receiving a stack of currency bills, rapidly counting and evaluating all the bills in the stack, and then re-stacking the bills, said device comprising

a feed mechanism for receiving a stack of currency bills and feeding said bills in the direction of the narrow dimension of the bills, one at a time, to a feed station,

a bill transport mechanism for transporting bills, in the direction of the narrow dimension of the bills, from said feed station to a stacking station, at a rate in excess of about 800 bills per minute.

a stationary optical scanning head located between said feed and stacking stations for scanning a preselected segment of a central portion of each bill transported between said stations by said transport mechanism, said scanning head including at least one light source for illuminating a strip of said preselected segment of a bill, and at least one detector for received reflected light from the illuminated strip on the bill and producing an output signal representing variations in the intensity of the reflected light.

sampling said output signal at preselected intervals as a bill is moved across said scanning head in the direction of the narrow dimension of the bill,

a memory for storing characteristic signal samples produced by scanning said preselected segments of bills of different denominations with said scanning head and sampling said output signal at said preselected intervals, and

signal processing means for receiving said signal samples and (1) determining the denomination of each scanned bill by comparing said stored signal samples with said output signal samples produced by the scanning of each bill with said scanning

head, (2) counting the number of scanned bills of each denomination, and (3) accumulating the cumulative value of the scanned bills of each denomination.

2. The currency counting and evaluation device of claim 1 which includes an encoder coupled to said transport mechanism for monitoring the movement of each bill by producing a repetitive tracking signal synchronized with incremental movements of said transport mechanism, and means urging each bill into firm engagement with said transport mechanism and said scanning head to ensure a fixed relationship between the increments of movement of each bill and the corresponding increments of movement of said transport mechanism which is synchronized with said encoder.

3. The currency counting and evaluation device of claim 1 wherein said transport mechanism is driven at a controllable speed.

4. The currency counting and evaluation device of claim 1 wherein said detector in said scanning head is a single photodetector which produces an electrical output signal proportional to the intensity of the light reflected from the scanned bill.

5. The currency counting and evaluation device of claim 4 which includes means for sampling said output signal at increments synchronized with said repetitive tracking signal, and at the same increments used in said characteristic signals stored in said memory.

6. The currency counting and evaluation device of claim 1 wherein said strips are dimensioned so that at least 50 different strips can be scanned in the direction of the narrow dimension of each bill.

7. The currency counting and evaluation device of claim 1 which includes means for detecting a borderline around the image printed on each bill, and wherein said preselected segment is located inside said borderline, and the scanning of said preselected segment is initiated at a prescribed interval following the detection of said borderline.

8. The currency counting and evaluation device of claim 1 wherein said preselected segment of each bill is located in the central region of the bill.

9. The currency counting and evaluation device of claim 1 wherein said feeding and stacking stations are both located at the front of said device, and said transport mechanism carries bills rearwardly away from said feed station and then returns the bills forwardly to said stacking station.

10. The currency counting and evaluation device of claim 9 wherein said transport mechanism forms a linear path for said bills on the upstream side of said stacking station, and said scanning head is located along said linear path.

11. The currency counting and evaluation device of claim 1 wherein said preselected segment of each bill is scanned in less than one tenth of a second.

12. The currency counting and evaluation device of claim 1 wherein said light source illuminates said preselected segment of each bill from opposite sides of said detector.

13. The currency counting and evaluation device of claim 1 which includes means for controlling the movement of a selected bill between said scanning head and the stacking station for that bill in response to said determination of the denomination of that bill.

14. The currency counting and evaluation device of claim 13 wherein said controlling means stops the movement of said selected bill between said scanning head and the stacking station for that bill.

15. The currency counting and evaluation device of claim 13 wherein said controlling means decelerates said selected bill before stopping the movement of that bill.

16. The currency counting and evaluation device of claim 1 wherein the denomination of each bill is determined before the leading edge of that bill reaches the stacking station for that bill.

17. The currency counting and evaluation device of claim 1 wherein said stacking station is spaced from said scanning head by a distance that is less than the width of two of said bills.

18. The currency counting and evaluation device of claim 1 which includes signal processing means responsive to the output signals from said detector for determining the denomination of each scanned bill before that bill has been advanced to a stacking station, and

means responsive to said signal processing means for altering the movement of a scanned bill in response to the denomination determination for that bill, before that bill is advanced to a stacking station.

19. An improved method for discriminating between currency bills of different denominations, each currency bill having printed indicia enclosed within a borderline defined thereupon so that the bill surface outside the borderline is substantially blank, comprising the steps of:

illuminating a predetermined section of a currency bill by focusing at least one strip of coherent light thereupon;

detecting the light reflected off said illuminated section of said bill to generate an analog reflectance signal;

generating relative lateral displacement between said strip of coherent light and said currency bill so as to illuminate or optically scan successive sections of said bill along a predetermined dimension thereof and enclosed within said borderline;

obtaining a series of analog reflectance signals corresponding to light reflected from each of said successive bill sections using a first relatively narrow strip of coherent light to detect said borderline as the currency bill moves across said strip by detecting the difference in magnitude of the reflectance signal obtained from the bill surface outside said borderline and the reflectance signal obtained about said borderline itself, and using a second relatively wide strip of coherent light to obtain



said reflectance signals representing said characteristic patterns after said borderline has been detected;

digitizing and processing said series of analog reflectance signals to yield a set of digital data samples which, in combination, represent a data pattern characteristic of the currency denomination of said bill;

generating and storing a set of master characteristic patterns corresponding to optical scanning of original bills of each of the different currency denominations to be discriminated; and

comparing the characteristic pattern for a scanned currency bill to each of said stored master patterns to determine the degree of correlation therebetween, and thereby to identify the denomination of said currency bill.

20. An improved method for discriminating between currency bills of different denominations comprising the steps of:

illuminating a predetermined section of a currency bill by focusing at least one strip of coherent light thereupon;

detecting the light reflected off said illuminated section of said bill to generate an analog reflectance signal;

generating relative lateral displacement between said strip of coherent light and said currency bill so as to illuminate or optically scan successive sections of said bill along a predetermined dimension thereof;

obtaining a series of analog reflectance signals corresponding to light reflected from each of said successive bill sections;

digitizing and processing said series of analog reflectance signals to yield a set of digital data samples which, in combination, represent a data pattern characteristic of the currency denomination of said bill;

generating and storing a set of master characteristic patterns corresponding to optical scanning of original bills of each of the different currency denominations to be discriminated;

comparing the characteristic pattern for a scanned currency bill to each of said stored master patterns to determine the degree of correlation therebetween, and thereby to identify the denomination of said currency bill; and

positively identifying said scanned bill as having the denomination corresponding to the stored master pattern for which the degree of correlation is found to be the highest and at least equal to a predefined correlation threshold.

21. The improved currency discrimination method according to claim 20 wherein any scanned bill which is not positively identified as having a particular currency denomination is identified as having an unidentifiable denomination.

22. Improved apparatus for discriminating and counting currency bills of different denominations comprising:

an input path for receiving currency bills to be discriminated and along which bills may be moved along a first direction;

an output path along which bills may be moved along a second direction;

a curved guideway disposed between said input and output paths and for accepting bills from said input path and guiding them along said second direction onto said output path; and

currency discrimination means located downstream of said curved guideway along said output path where said bills are guided in a substantially straight manner.

23. The improved currency discrimination apparatus as set forth in claim 22 wherein said currency discrimination means includes:

means for illuminating a predetermined section of a currency bill by focusing at least one strip of coherent light thereupon;

means for detecting the light reflected off said illuminated section of said bill at selected time intervals as the bill is moved across said light strip in order to generate a series of analog reflectance signals;

means for digitizing and processing said reflectance signals to yield a set of digital samples which, in combination, represent a data pattern characteristic of the currency denomination of said bill;

means for generating and storing a set of master characteristic patterns corresponding to optical scanning of original bills of each of the currency denominations to be discriminated; and

means for comparing the characteristic pattern for a scanned currency bill to each of said stored master patterns to determine the degree of correlation therebetween, and thereby to identify the denomination of said currency bill.

24. The improved currency discrimination apparatus as set forth in claim 22 wherein currency bills having a wide dimension and a narrow dimension are moved along said input path, along said curved guideway, and along said output path with their narrow dimension maintained substantially parallel to the direction of movement.

25. The improved currency discrimination apparatus as set forth in claim 23 wherein said currency bills have printed indicia characterizing bill denomination, said indicia being enclosed by a borderline defined thereupon, the bill surface outside said borderline being substantially blank, and further wherein said currency discrimination means generates said characteristic patterns by obtaining said reflectance signals from the bill surface contained within said borderline.

26. The improved currency discrimination apparatus as set forth in claim 25 wherein said currency discrimination means includes means for focusing a first relatively narrow strip of coherent light onto said currency bills in order to detect said borderline as the currency bills move across said strip by detecting the difference in magnitude of the reflectance signal obtained from the bill surface outside said borderline and the reflectance signal obtained about said borderline itself.

27. The improved currency discrimination apparatus as set forth in claim 26 wherein said currency discrimination means includes means for focusing a second relatively wide strip of coherent light upon said currency bills for obtaining said reflectance signals representing said characteristic patterns after said borderline has been detected using said narrow strip of light.

## **ABSTRACT OF THE DISCLOSURE**

An improved method and apparatus for discriminating between currency bills of different denominations uses an optical sensing and correlation technique based on the sensing of bill reflectance characteristics obtained by illuminating and scanning a bill along its narrow dimension. A series of detected reflectance signals are obtained by sampling and digitally processing, under microprocessor control, the reflected light at a plurality of predefined sample points as a currency bill is moved across an illuminated strip with its narrow dimension parallel to the direction of transport of the bill. The sample data is subjected to digital processing, including a normalizing process, whereby the reflectance data represents a characteristic pattern that is unique for a given bill denomination and incorporates sufficient distinguishing features between characteristic patterns for discriminating between different currency denominations. A plurality of master characteristic patterns are generated and stored using original bills for each denomination of currency to be detected. The pattern generated by scanning a bill under test and processing the data samples is compared with each of the prestored master patterns to generate, for each comparison, a correlation number representing the extent of similarity between corresponding ones of the plurality of data samples for the compared patterns. Denomination identification is based on designating the scanned bill as belonging to the denomination corresponding to the stored master pattern for which the correlation number resulting from pattern comparison is determined to be the highest, subject to a bi-level threshold of correlation.

**47171-00261USC2 – Pending Claims after Amendment A**

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19. An improved method for discriminating between currency bills of different denominations, each currency bill having printed indicia enclosed within a borderline defined thereupon so that the bill surface outside the borderline is substantially blank, comprising the steps of:

illuminating a predetermined section of a currency bill by focusing at least one strip of coherent light thereupon;

detecting the light reflected off said illuminated section of said bill to generate an analog reflectance signal;

generating relative lateral displacement between said strip of coherent light and said currency bill so as to illuminate or optically scan successive sections of said bill along a predetermined dimension thereof and enclosed within said borderline;

obtaining a series of analog reflectance signals corresponding to light reflected from each of said successive bill sections using a first relatively narrow strip of coherent light to detect said borderline as the currency bill moves across said strip by detecting the difference in magnitude of the reflectance signal obtained about said borderline itself, and using a second relatively wide strip of coherent light to obtain said reflectance signals representing said characteristic patterns after said borderline has been detected;

digitizing and processing said series of analog reflectance signals to yield a set of digital data samples which, in combination, represent a data pattern characteristic of the currency denomination of said bill;

generating and storing a set of master characteristic patterns corresponding to optical scanning of original bills of each of the different currency denominations to be discriminated; and

comparing the characteristic pattern for a scanned currency bill to each of said stored master patterns to determine the degree of correlation therebetween, and thereby to identify the denomination of said currency bill.

28. A U.S. currency evaluation device for receiving a stack of U.S. currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of U.S. denominations.

29. The currency evaluation device of claim 28 wherein the detector is adapted to detect reflected light and generate a reflected light characteristic output signal.

30. The currency evaluation device of claim 29 wherein the discriminating unit is adapted to denominate bills based solely on the detection of reflected light.

31. The currency evaluation device of claim 28 wherein the detector is an optical detector adapted to generate an optical characteristic output signal.

32. The currency evaluation device of claim 31 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate of at least about 800 bills per minute.

33. The currency evaluation device of claim 31 wherein the discriminating unit is adapted to denominate bills based solely on the detection of optical characteristic information.

34. The currency evaluation device of claim 33 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate of at least about 1000 bills per minute.

35. The currency evaluation device of claim 28 wherein the processor is adapted to generate a scanned pattern from each of the bills based on the characteristic information output signal and determine the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

36. A U.S. currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- a single input receptacle positioned to receive a stack of bills to be evaluated;
- a single output receptacle positioned to receive the bills after the bills have been evaluated;
- a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;
- a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of U.S. denominations; and



a flagging device comprising the processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills, the processor generating a no call signal when the denomination of a bill is not determined by the processor.

37. The currency evaluation device of claim 36 wherein the processor is coupled to the transport mechanism and is programmed to cause the transport mechanism to halt when the denomination of a bill is not determined by the processor.

38. The currency evaluation device of claim 36 wherein the processor generates a scanned pattern from each of the bills based on the characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of U.S. bills, the master patterns being stored in a memory.

39. The currency evaluation device of claim 38 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

40. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

a single input receptacle positioned to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a

processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of denominations independently of the dimensions of the bills.

41. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- a single input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

- a single output receptacle adapted to receive the bills after the bills have been evaluated;

- a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

- a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor, the discriminating unit counting and determining the denomination of the bills;

- wherein the processor is programmed to flag a bill when the denomination of the bill is not determined by the discriminating unit, the processor generating a no call signal when the denomination of a bill is not determined by the processor, and wherein the processor is coupled to the transport mechanism and is programmed to cause the transport mechanism to halt when the denomination of a bill is not determined.

42. The device of claim 41 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position.

43. The device of claim 41 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being the last bill transported to the output receptacle.

44. The device of claim 41 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position within the output receptacle.

45. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- a input receptacle positioned to receive a stack of bills to be evaluated;
- a single output receptacle positioned to receive the bills after the bills have been evaluated;

- a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

- a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of denominations, bills of at least two of the plurality of denominations having the same size; and

- a flagging device comprising the processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills, the processor generating a no call signal when the denomination of a bill is not determined by the processor.

46. The currency evaluation device of claim 45 wherein the processor generates a scanned pattern from each of the bills based on the characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

47. The currency evaluation device of claim 46 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

48. A high-speed compact, single input receptacle, single output receptacle currency denominating device for receiving a stack of currency bills having a plurality of denominations and rapidly denominating the bills in the stack, the device comprising:

- an input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

- a single output receptacle adapted to receive the bills after the bills have been evaluated;

- a transport mechanism adapted to transport the bills in the direction of the narrow dimension of the bills, one at a time, from the input receptacle to the output receptacle along a transport path at a rate in excess of about 800 bills per minute;

- a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations at a rate in excess of about 800 bills per minute, bills of at least two of the denominations having the same dimensions, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle, the discriminating unit counting and determining the denomination of the bills.

49. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- a single input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations by scanning images associated with each of the bills, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor, the discriminating unit counting and determining the denomination of the bills;

wherein the processor is programmed to flag a bill when the denomination of the bill is not determined by the discriminating unit; and wherein the processor is programmed to generate a no call signal when the denomination of a bill is not determined by the processor.

50. The device of claim 49 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position.

51. The device of claim 49 wherein is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being the last bill delivered to the output receptacle.

52. The device of claim 49 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position within the output receptacle.

53. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating an image characteristic information output signal in response to detected characteristic information, the output signal being associated with images associated with the bills, the characteristic information output signal being electrically coupled to the processor, the processor receiving the image characteristic information output signal and generating a denomination signal in response thereto.

54. The currency evaluation device of claim 53 wherein the detector is adapted to detect reflected light and generate a reflected light characteristic output signal.

55. The currency evaluation device of claim 54 wherein the discriminating unit is adapted to denominate bills based solely on the detection of reflected light.

56. The currency evaluation device of claim 53 wherein the detector is an optical detector adapted to generate an optical characteristic output signal.

57. The currency evaluation device of claim 56 wherein the discriminating unit is adapted to denominate bills based solely on the detection of optical characteristic information.

58. The currency evaluation device of claim 57 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate of at least about 800 bills per minute.

59. The currency evaluation device of claim 53 wherein the processor is adapted to generate a scanned pattern from each of the bills based on the characteristic

information output signal and determine the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

60. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

a discriminating unit comprising an image detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating an image characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the image characteristic information output signal and generating a denomination signal in response thereto; and

a flagging device comprising the processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills, the processor generating a no call signal when the denomination of a bill is not determined by the processor.

61. The currency evaluation device of claim 60 wherein the processor generates a scanned pattern from each of the bills based on the characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

62. The currency evaluation device of claim 61 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

63. A high-speed compact, single input receptacle, single output receptacle currency denominating device for receiving a stack of currency bills having a plurality of denominations and rapidly denominating the bills in the stack, the device comprising:

- an input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

- a single output receptacle adapted to receive the bills after the bills have been evaluated;

- a transport mechanism adapted to transport the bills in the direction of the narrow dimension of the bills, one at a time, from the input receptacle to the output receptacle along a transport path at a rate in excess of about 800 bills per minute;

- a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations at a rate in excess of about 800 bills per minute, the bills the discriminating unit is adapted to denominate having images associated therewith corresponding to the plurality of denominations that the discriminating unit is adapted to denominate, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle, the detector being adapted to scan passing bills and generate image signals, the discriminating unit determining the denomination of the bills based on the image signals.

64. A method of processing U.S. currency using a U.S. currency denominating device having a single input receptacle and a single output receptacle comprising:

- receiving a stack of U.S. bills having a plurality of denominations to be evaluated in a single input receptacle of the currency denominating device;

- receiving the bills in a single output receptacle of the currency denominating device after the bills have been evaluated;



transporting the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path;

determining the denomination of each of the bills including bills of a plurality of U.S. denominations.

65. A method of processing U.S. currency using a U.S. currency evaluation device having a single input receptacle and a single output receptacle comprising:

receiving a stack of U.S. bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device;

receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path;

determining the denomination of each of the bills including bills of a plurality of U.S. denominations using a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor;

flagging a bill when the denomination of the bill is not determined by the discriminating unit by halting the transporting of the bills.

66. The method of claim 65 comprising halting the transporting with the bill whose denomination has not been determined being located at a predetermined position.

67. The method of claim 65 comprising halting the transporting with the bill whose denomination has not been determined being the last bill delivered to the output receptacle.

68. A method of processing currency using a currency evaluation device comprising:

receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device;

receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

determining the denomination of each of the bills including bills of a plurality of denominations having the same size using a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor;

flagging a bill when the denomination of the bill is not determined by the discriminating unit by generating a no call signal.

69. The method of claim 68 comprising halting the transporting with the bill whose denomination has not been determined being located at a predetermined position in response to the generation of a no call signal.

70. The method of claim 68 comprising halting the transporting with the bill whose denomination has not been determined being the last bill delivered to the output receptacle in response to the generation of a no call signal.

71. A method of processing currency using a currency evaluation device comprising:

receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device, bills of at least two of the plurality of denominations having the same dimensions;

receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to the output receptacle along a transport path using a transport mechanism comprising a transport drive motor and transport rollers;

determining, independently of the size of the bills, the denomination of each of the bills including bills of a plurality of denominations using a discriminating unit

comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor; wherein determining the denomination comprises:

- the detector detecting characteristic information from the bills;
- the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor;
- the processor receiving the characteristic information output signal; and
- the processor generating a denomination signal in response thereto.

72. A method of processing currency bills having a plurality of denominations using a currency denominating device having a single input receptacle and a single output receptacle comprising:

- receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle;
- receiving the bills after the bills have been evaluated in a single output receptacle of the device;
- transporting the bills in the direction of the narrow dimension of the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path at a rate in excess of about 800 bills per minute; and
- counting and denominating the bills including bills of a plurality of denominations at a rate in excess of about 800 bills per minute, denominating comprising scanning images associated with the bills.

73. A method of processing currency using a currency evaluation device comprising:

- receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device;
- receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path;

scanning the bills and retrieving images associated therewith;

determining the denomination of each of the bills using the retrieved images, wherein determining the denomination comprises using a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor;

flagging a bill when the denomination of the bill is not determined by the discriminating unit by generating a no call signal.

74. The method of claim 73 comprising halting the transporting in response to the generation of a no call signal with the bill whose denomination has not been determined being located at a predetermined position.

75. The method of claim 73 comprising halting the transporting in response to the generation of a no call signal with the bill whose denomination has not been determined being the last bill delivered to the output receptacle.

Customer No. 30223

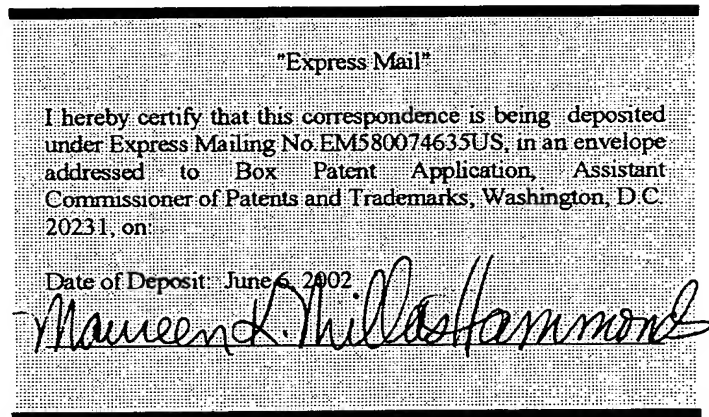
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re continuation of: )  
)  
Application of: Donald E. Raterman et. al. )  
Application No.: 09/453,200 ) Atty. Dkt: 47171-00261USC2  
Filed: December 2, 1999 )  
Group Art: 2621 )  
)  
For: Method And Apparatus For )  
Currency Discrimination )  
And Counting )

**PRELIMINARY AMENDMENT "A"**

Honorable Commissioner of  
Patents and Trademarks  
Washington, D.C. 20231



Dear Sir:

This application is a continuing application of pending prior application Serial No. 09/453,200, filed December 2, 1999 entitled "Method and Apparatus for Discrimination and Counting." Application 09/453,200 is a continuation of application Serial No. 08/841,203, filed April 29, 1997 entitled "Method and Apparatus for Currency Discrimination and Counting" and issued as U.S. Pat. No. 6,028,951 on February 22, 2000. Application Serial No. 08/841,203 is a continuation of 08/339,337, filed on November 14, 1994, entitled "Method And Apparatus For Currency Discrimination And Counting" and issued as U.S. Pat. No. 5,692,067 on November 25, 1997, which in turn is a continuation of 08/127,334, filed on September 27, 1993, and issued as U.S. Pat. No. 5,467,405 on November 14, 1995, which in turn is a continuation of application Serial No. 07/885,648, filed May 19,

1992, and issued as Patent No. 5,295,196 on March 15, 1994, which in turn is a continuation-in-part of application Serial No. 07/475,111, filed February 5, 1990, and now abandoned.

IN THE SPECIFICATION:

Please amend the specification by deleting the cross-reference section at page 1, lines 3-5 and inserting therefore the following:

-- This application is a continuing application of pending prior application Serial No. 09/453,200, filed December 2, 1999 entitled "Method and Apparatus for Currency Discrimination and Counting." Serial No. 09/453,200 is a continuation of pending Serial No. 08/841,203, filed April 29, 1997 entitled "Method And Apparatus For Currency Discrimination And Counting," now issued as U.S. Pat. No. 6,028,951. Application Serial No. 08/841,203 is a continuation of 08/339,337, filed on November 14, 1994, and issued as U.S. Pat. No. 5,692,067, which in turn is a continuation of 08/127,334, filed on September 27, 1993, and issued as U.S. Pat. No. 5,467,405, which in turn is a continuation of application Serial No. 07/885,648, filed May 19, 1992, and issued as Patent No. 5,295,196, which in turn is a continuation-in-part of application Serial No. 07/475,111, filed February 5, 1990, and now abandoned. All of the above applications and patents are incorporated herein by reference in their entirety.--

IN THE CLAIMS:

Cancel claims 1-18 and 20-27.

Please add the following new claims 28-75:

28. A U.S. currency evaluation device for receiving a stack of U.S. currency bills and rapidly evaluating all the bills in the stack, the device comprising:  
an input receptacle positioned to receive a stack of bills to be evaluated;  
a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of U.S. denominations.

29. The currency evaluation device of claim 28 wherein the detector is adapted to detect reflected light and generate a reflected light characteristic output signal.

30. The currency evaluation device of claim 29 wherein the discriminating unit is adapted to denominate bills based solely on the detection of reflected light.

31. The currency evaluation device of claim 28 wherein the detector is an optical detector adapted to generate an optical characteristic output signal.

32. The currency evaluation device of claim 31 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate of at least about 800 bills per minute.

33. The currency evaluation device of claim 31 wherein the discriminating unit is adapted to denominate bills based solely on the detection of optical characteristic information.

34. The currency evaluation device of claim 33 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate of at least about 1000 bills per minute.

35. The currency evaluation device of claim 28 wherein the processor is adapted to generate a scanned pattern from each of the bills based on the characteristic information output signal and determine the denomination of a bill by comparing the

scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

36. A U.S. currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- a single input receptacle positioned to receive a stack of bills to be evaluated;

- a single output receptacle positioned to receive the bills after the bills have been evaluated;

- a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

- a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of U.S. denominations; and

- a flagging device comprising the processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills, the processor generating a no call signal when the denomination of a bill is not determined by the processor.

37. The currency evaluation device of claim 36 wherein the processor is coupled to the transport mechanism and is programmed to cause the transport mechanism to halt when the denomination of a bill is not determined by the processor.

38. The currency evaluation device of claim 36 wherein the processor generates a scanned pattern from each of the bills based on the characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of U.S. bills, the master patterns being stored in a memory.



39. The currency evaluation device of claim 38 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

40. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

a single input receptacle positioned to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of denominations independently of the dimensions of the bills.

41. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

a single input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations, bills of at least two of

the denominations having the same dimensions, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor, the discriminating unit counting and determining the denomination of the bills;

wherein the processor is programmed to flag a bill when the denomination of the bill is not determined by the discriminating unit, the processor generating a no call signal when the denomination of a bill is not determined by the processor, and wherein the processor is coupled to the transport mechanism and is programmed to cause the transport mechanism to halt when the denomination of a bill is not determined.

42. The device of claim 41 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position.

43. The device of claim 41 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being the last bill transported to the output receptacle.

44. The device of claim 41 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position within the output receptacle.

45. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

a input receptacle positioned to receive a stack of bills to be evaluated;

a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor,

the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, the discriminating unit being adapted to denominate bills of a plurality of denominations, bills of at least two of the plurality of denominations having the same size; and

a flagging device comprising the processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills, the processor generating a no call signal when the denomination of a bill is not determined by the processor.

46. The currency evaluation device of claim 45 wherein the processor generates a scanned pattern from each of the bills based on the characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

47. The currency evaluation device of claim 46 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

48. A high-speed compact, single input receptacle, single output receptacle currency denominating device for receiving a stack of currency bills having a plurality of denominations and rapidly denominating the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills in the direction of the narrow dimension of the bills, one at a time, from the input receptacle to the output receptacle along a transport path at a rate in excess of about 800 bills per minute;

a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations at a rate in excess of about 800 bills per minute, bills of at least two of the denominations having the same dimensions, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle, the discriminating unit counting and determining the denomination of the bills.

49. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

a single input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations by scanning images associated with each of the bills, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor, the discriminating unit counting and determining the denomination of the bills;

wherein the processor is programmed to flag a bill when the denomination of the bill is not determined by the discriminating unit; and wherein the processor is programmed to generate a no call signal when the denomination of a bill is not determined by the processor.

50. The device of claim 49 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position.

51. The device of claim 49 wherein is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being the last bill delivered to the output receptacle.

52. The device of claim 49 wherein the processor is programmed to cause the transport mechanism to halt with the bill whose denomination has not been determined being located at a predetermined position within the output receptacle.

53. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path; and

a denomination discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating an image characteristic information output signal in response to detected characteristic information, the output signal being associated with images associated with the bills, the characteristic information output signal being electrically coupled to the processor, the processor receiving the image characteristic information output signal and generating a denomination signal in response thereto.

54. The currency evaluation device of claim 53 wherein the detector is adapted to detect reflected light and generate a reflected light characteristic output signal.

55. The currency evaluation device of claim 54 wherein the discriminating unit is adapted to denominate bills based solely on the detection of reflected light.

56. The currency evaluation device of claim 53 wherein the detector is an optical detector adapted to generate an optical characteristic output signal.

57. The currency evaluation device of claim 56 wherein the discriminating unit is adapted to denominate bills based solely on the detection of optical characteristic information.

58. The currency evaluation device of claim 57 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate of at least about 800 bills per minute.

59. The currency evaluation device of claim 53 wherein the processor is adapted to generate a scanned pattern from each of the bills based on the characteristic information output signal and determine the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

60. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

a single output receptacle positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

a discriminating unit comprising an image detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating an image characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the image characteristic information output signal and generating a denomination signal in response thereto; and

a flagging device comprising the processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills, the processor generating a no call signal when the denomination of a bill is not determined by the processor.

61. The currency evaluation device of claim 60 wherein the processor generates a scanned pattern from each of the bills based on the characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory.

62. The currency evaluation device of claim 61 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

63. A high-speed compact, single input receptacle, single output receptacle currency denominating device for receiving a stack of currency bills having a plurality of denominations and rapidly denominating the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills having a plurality of denominations to be evaluated;

a single output receptacle adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills in the direction of the narrow dimension of the bills, one at a time, from the input receptacle to the output receptacle along a transport path at a rate in excess of about 800 bills per minute;

a denomination discriminating unit adapted to determine the denomination of each of the bills including bills of a plurality of denominations at a rate in excess of about 800 bills per minute, the bills the discriminating unit is adapted to denominate having images associated therewith corresponding to the plurality of denominations that the discriminating unit is adapted to denominate, the discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle, the detector being adapted to scan passing bills and generate image signals, the discriminating unit determining the denomination of the bills based on the image signals.

64. A method of processing U.S. currency using a U.S. currency denominating device having a single input receptacle and a single output receptacle comprising:

- receiving a stack of U.S. bills having a plurality of denominations to be evaluated in a single input receptacle of the currency denominating device;
- receiving the bills in a single output receptacle of the currency denominating device after the bills have been evaluated;
- transporting the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path;
- determining the denomination of each of the bills including bills of a plurality of U.S. denominations.

65. A method of processing U.S. currency using a U.S. currency evaluation device having a single input receptacle and a single output receptacle comprising:

- receiving a stack of U.S. bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device;
- receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;
- transporting the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path;
- determining the denomination of each of the bills including bills of a plurality of U.S. denominations using a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor;
- flagging a bill when the denomination of the bill is not determined by the discriminating unit by halting the transporting of the bills.

66. The method of claim 65 comprising halting the transporting with the bill whose denomination has not been determined being located at a predetermined position.



67. The method of claim 65 comprising halting the transporting with the bill whose denomination has not been determined being the last bill delivered to the output receptacle.

68. A method of processing currency using a currency evaluation device comprising:

receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device;

receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to the output receptacle along a transport path;

determining the denomination of each of the bills including bills of a plurality of denominations having the same size using a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor;

flagging a bill when the denomination of the bill is not determined by the discriminating unit by generating a no call signal.

69. The method of claim 68 comprising halting the transporting with the bill whose denomination has not been determined being located at a predetermined position in response to the generation of a no call signal.

70. The method of claim 68 comprising halting the transporting with the bill whose denomination has not been determined being the last bill delivered to the output receptacle in response to the generation of a no call signal.

71. A method of processing currency using a currency evaluation device comprising:

receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device, bills of at least two of the plurality of denominations having the same dimensions;

receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to the output receptacle along a transport path using a transport mechanism comprising a transport drive motor and transport rollers;

determining, independently of the size of the bills, the denomination of each of the bills including bills of a plurality of denominations using a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor; wherein determining the denomination comprises:

- the detector detecting characteristic information from the bills;
- the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor;
- the processor receiving the characteristic information output signal;
- and
- the processor generating a denomination signal in response thereto.

72. A method of processing currency bills having a plurality of denominations using a currency denominating device having a single input receptacle and a single output receptacle comprising:

receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle;

receiving the bills after the bills have been evaluated in a single output receptacle of the device;

transporting the bills in the direction of the narrow dimension of the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path at a rate in excess of about 800 bills per minute; and

counting and denominating the bills including bills of a plurality of denominations at a rate in excess of about 800 bills per minute; denominating comprising scanning images associated with the bills.

73. A method of processing currency using a currency evaluation device comprising:

receiving a stack of bills having a plurality of denominations to be evaluated in a single input receptacle of the evaluation device;

receiving the bills after the bills have been evaluated in a single output receptacle of the evaluation device;

transporting the bills, one at a time, from the single input receptacle to the single output receptacle along a transport path;

scanning the bills and retrieving images associated therewith;

determining the denomination of each of the bills using the retrieved images, wherein determining the denomination comprises using a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and a processor;

flagging a bill when the denomination of the bill is not determined by the discriminating unit by generating a no call signal.

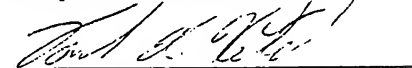
74. The method of claim 73 comprising halting the transporting in response to the generation of a no call signal with the bill whose denomination has not been determined being located at a predetermined position.

75. The method of claim 73 comprising halting the transporting in response to the generation of a no call signal with the bill whose denomination has not been determined being the last bill delivered to the output receptacle.

### **REMARKS**

The Commissioner is authorized to charge any additional fees which may be required (except payment of the issue fee), or credit any overpayment, to Deposit Account No. 10/0447, Order No. 47171-00261USC2.

Respectfully submitted,



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PATENT

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In Re Application Of:

Raterman et al.

Application No: 09/733,117

Filed: December 8, 2000

For: Method and Apparatus For Currency  
Discrimination and Counting

) Atty. Dkt No.: 47171-00282USC2

)

) Examiner: Phuoc Tran

)

) Group Art Unit: 2621

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**CERTIFICATE OF MAILING**

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail, postage prepaid, in an envelope addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231, on June 26, 2002.

Signature: Maurice Hammond

**REPLY TO OFFICE ACTION DATED MARCH 26, 2002**

Honorable Commissioner of  
Patents and Trademarks  
Washington, D.C. 20231

Dear Sir:

This paper is filed in response to the Office Action dated March 26, 2002.

**REMARKS**

Claims 28-33 are pending and stand rejected under the judicially created doctrine of obviousness-type double patenting.

**Double Patenting Rejection**

All pending claims were rejected based on obvious-type double patenting based on claim 1 of U.S. Pat. No. 6,073,744 in view of "Description of Toshiba-Mosler CF-420 Device."

Applicants respectfully traverse this rejection. Nonetheless, in order to advance the prosecution of the present application, a terminal disclaimer is being filed concurrently with this reply to overcome this rejection.

### **CONCLUSION**

In view of the above remarks, favorable reconsideration and allowance of the pending claims is respectfully requested.

No fees are believed due in conjunction with this reply. Nonetheless, if this is incorrect, the Commissioner is authorized to charge any additional fees which may be required (except payment of the issue fee), or credit any overpayment, to Deposit Account No. 10-0447, 47171-00282USC2.

If there are any matters which may be resolved or clarified through a telephone interview, the Examiner is respectfully requested to contact Applicants' undersigned attorney at the number indicated.

Dated: 6/26/02

Respectfully submitted,



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**Pending Claims After Reply to  
Office Action Mailed March 26, 2002**

28. A compact currency evaluation device for identifying currency bills of different denominations comprising:

a housing;

an input bin mounted to said housing;

a denomination discriminating unit in said housing adapted to determine the denominations of said bills of different denominations independently of the dimensions of the bills;

an output bin mounted to said housing;

a transport path for transporting bills through said housing from said input bin past said discriminating unit and to said output bin, said transport path being oriented relative to said input bin such that bills are redirected through an angle greater than 90° in the direction of the output bin to reach said transport path from said input bin;

a first roller having one portion extending into said input bin and another portion extending into said transport path, said first roller redirecting said bill from said input bin to said transport path;

a first transport roller located along said transport path and spaced apart from said first roller by a distance such that respective lines along which each of said rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than a narrow dimension of a bill;

a second transport roller located along said transport path and spaced apart from said first transport roller by a distance such that respective lines along which each of said rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than the narrow dimension of a bill; and

at least one stacker wheel having one portion extending into said transport path and another portion extending into said output bin, said stacker wheel being located along said transport path and spaced apart from said second transport roller by a distance such that respective lines along which said stacker wheel and said second transport roller

contact a bill in said transport path are spaced apart along said transport path by a distance less than the narrow dimension of a bill.

29. A compact currency evaluation device for identifying U.S. currency bills of different denominations comprising:

- a housing;

- an input bin mounted to said housing;

- a denomination discriminating unit in said housing adapted to determine the denominations of U.S. bills of a plurality of denominations;

- an output bin mounted to said housing;

- a transport path for transporting U.S. bills through said housing from said input bin past said discriminating unit and to said output bin, said transport path being oriented relative to said input bin such that bills are redirected through an angle greater than 90° in the direction of the output bin to reach said transport path from said input bin;

- a first roller having one portion extending into said input bin and another portion extending into said transport path, said first roller redirecting said bill from said input bin to said transport path;

- a first transport roller located along said transport path and spaced apart from said first roller by a distance such that respective lines along which each of said rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than a narrow dimension of a bill;

- a second transport roller located along said transport path and spaced apart from said first transport roller by a distance such that respective lines along which each of said rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than the narrow dimension of a bill; and

- at least one stacker wheel having one portion extending into said transport path and another portion extending into said output bin, said stacker wheel being located along said transport path and spaced apart from said second transport roller by a distance such that respective lines along which said stacker wheel and said second transport roller contact a bill in said transport path are spaced apart along said transport path by a distance less than the narrow dimension of a bill.

30. A compact currency evaluation device for identifying currency bills of different denominations comprising:

a housing;

an input bin mounted to said housing;

a denomination discriminating unit in said housing adapted to determine the denomination of each of said bills, including bills of a plurality of denominations, bills of at least two of said plurality of denominations having the same dimensions;

an output bin mounted to said housing;

a transport path for transporting bills through said housing from said input bin past said discriminating unit and to said output bin, said transport path being oriented relative to said input bin such that bills are redirected through an angle greater than 90° in the direction of the output bin to reach said transport path from said input bin;

a first roller having one portion extending into said input bin and another portion extending into said transport path, said first roller redirecting said bill from said input bin to said transport path;

a first transport roller located along said transport path and spaced apart from said first roller by a distance such that respective lines along which each of said rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than a narrow dimension of a bill;

a second transport roller located along said transport path and spaced apart from said first transport roller by a distance such that respective lines along which each of said rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than the narrow dimension of a bill; and

at least one stacker wheel having one portion extending into said transport path and another portion extending into said output bin, said stacker wheel being located along said transport path and spaced apart from said second transport roller by a distance such that respective lines along which said stacker wheel and said second transport roller contact a bill in said transport path are spaced apart along said transport path by a distance less than the narrow dimension of a bill.



31. A compact currency evaluation device for identifying currency bills of different denominations comprising:

a housing;

an input bin mounted to said housing;

a discriminating unit in said housing adapted to determine the denominations of said bills;

an output bin mounted to said housing;

a transport path for transporting bills through said housing from said input bin past said discriminating unit and to said output bin, said transport path being oriented relative to said input bin such that bills are redirected through an angle greater than 90° in the direction of the output bin to reach said transport path from said input bin;

said discriminating unit comprising a detector positioned along the transport path between the input bin and the output bin, and a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor receiving the characteristic information output signal and generating a denomination signal in response thereto, and wherein the processor generates a scanned pattern from each of the bills based on the characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in a memory;

a first roller having one portion extending into said input bin and another portion extending into said transport path, said first roller redirecting said bill from said input bin to said transport path;

a first transport roller located along said transport path and spaced apart from said first roller by a distance such that respective lines along which each of said rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than a narrow dimension of a bill;

a second transport roller located along said transport path and spaced apart from said first transport roller by a distance such that respective lines along which each of said

rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than the narrow dimension of a bill; and

at least one stacker wheel having one portion extending into said transport path and another portion extending into said output bin, said stacker wheel being located along said transport path and spaced apart from said second transport roller by a distance such that respective lines along which said stacker wheel and said second transport roller contact a bill in said transport path are spaced apart along said transport path by a distance less than the narrow dimension of a bill.

32. A compact currency evaluation device for identifying currency bills of different denominations comprising:

a housing;

an input bin mounted to said housing;

a denomination discriminating unit in said housing adapted to determine the denominations of said bills;

an output bin mounted to said housing;

a transport path for transporting bills through said housing from said input bin past said discriminating unit and to said output bin, said transport path being oriented relative to said input bin such that bills are redirected through an angle greater than 90° in the direction of the output bin to reach said transport path from said input bin;

said denomination discriminating unit comprising a detector positioned along the transport path between the input bin and the output bin, and a processor, the detector generating an image characteristic information output signal in response to detected characteristic information, the output signal being associated with images associated with the bills, the characteristic information output signal being electrically coupled to the processor, the processor receiving the image characteristic information output signal and generating a denomination signal in response thereto;

a first roller having one portion extending into said input bin and another portion extending into said transport path, said first roller redirecting said bill from said input bin to said transport path;

a first transport roller located along said transport path and spaced apart from said first roller by a distance such that respective lines along which each of said rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than a narrow dimension of a bill;

a second transport roller located along said transport path and spaced apart from said first transport roller by a distance such that respective lines along which each of said rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than the narrow dimension of a bill; and

at least one stacker wheel having one portion extending into said transport path and another portion extending into said output bin, said stacker wheel being located along said transport path and spaced apart from said second transport roller by a distance such that respective lines along which said stacker wheel and said second transport roller contact a bill in said transport path are spaced apart along said transport path by a distance no greater than the narrow dimension of a bill.

33. A compact currency evaluation device for identifying currency bills of different denominations comprising:

a housing;

an input bin mounted to said housing;

a discriminating unit in said housing adapted to determine the denominations of said bills by scanning images associated with the bills;

an output bin mounted to said housing;

a transport path for transporting bills through said housing from said input bin past said discriminating unit and to said output bin, said transport path being oriented relative to said input bin such that bills are redirected through an angle greater than 90° in the direction of the output bin to reach said transport path from said input bin;

a first roller having one portion extending into said input bin and another portion extending into said transport path, said first roller redirecting said bill from said input bin to said transport path;

a first transport roller located along said transport path and spaced apart from said first roller by a distance such that respective lines along which each of said rollers

contacts a bill in said transport path are spaced apart along said transport path by a distance less than a narrow dimension of a bill;

a second transport roller located along said transport path and spaced apart from said first transport roller by a distance such that respective lines along which each of said rollers contacts a bill in said transport path are spaced apart along said transport path by a distance less than the narrow dimension of a bill; and

at least one stacker wheel having one portion extending into said transport path and another portion extending into said output bin, said stacker wheel being located along said transport path and spaced apart from said second transport roller by a distance such that respective lines along which said stacker wheel and said second transport roller contact a bill in said transport path are spaced apart along said transport path by a distance no greater than the narrow dimension of a bill.

**PENDING CLAIMS**

164. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills to be evaluated;

exactly two output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

a discriminating unit adapted to count and denominate the bills, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles; and

a processor programmed to determine whether the bills meet or fail to meet a non-piece count related criterion, the processor being programmed to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill, the processor being adapted to cause the transport mechanism to halt with a flagged bill being positioned as the last bill in one of the output receptacles.

165. The currency evaluation device of claim 164 wherein the input receptacle is adapted to receive and the discriminating unit is adapted to denominate bills of a plurality of United States denominations.

166. The currency evaluation device of claim 164 wherein the discriminating unit is adapted to denominate currency bills independently of the size of the bills.

167. The currency evaluation device of claim 164 wherein the device is adapted to deliver and at least one output receptacle is adapted to receive denominated bills of more than one denomination.

168. The currency evaluation device of claim 164 wherein the processor is adapted to cause the transport mechanism to halt when the discriminating unit is not able to determine the denomination of a bill, a bill whose denomination is not determined by the discriminating unit being termed a no call bill, the processor being adapted to cause the transport mechanism to halt with a no call bill being positioned at an identifiable location in one of the output receptacles.

169. The currency evaluation device of claim 164 wherein bills whose denomination are determined by the discriminating unit are delivered to a first output receptacle and wherein bills whose denomination are not determined by the discriminating unit are directed to the other output receptacle, bills whose denomination are not determined by the discriminating unit being termed no call bills.

170. The currency evaluation device of claim 169 wherein the processor is adapted to cause the transport mechanism to halt after a no call bill has been delivered to the second output receptacle.

171. The currency evaluation device of claim 170 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill being positioned at an identifiable location in the second output receptacle.

172. The currency evaluation device of claim 171 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill being the last bill transported to the second output receptacle, wherein the criterion is the discriminating unit determining the denomination of a bill and wherein a bill failing to meet the criterion of having its denomination determined by the discriminating unit is a flagged bill.

173. The currency evaluation device of claim 169 wherein the processor is adapted to cause the transport mechanism to halt before a no call bill has been delivered to the second output receptacle.

174. The currency evaluation device of claim 173 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill being located at an identifiable location within the transport mechanism.

175. The currency evaluation device of claim 164 wherein a bill failing to have its denomination determined by the discriminating unit is termed a no call bill, wherein the discriminating unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill, and wherein the device is adapted to deliver stranger bills to a first output receptacle and deliver no call bills to the other output receptacle.

176. The currency evaluation device of claim 164 wherein the discrimination unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the non-piece count related criterion is the discriminating unit determining that a bill is a stranger bill.

177. The currency evaluation device of claim 164 wherein the discrimination unit is further adapted to determine whether a bill is suspect, a bill determined to be suspect being termed a suspect bill.

178. The currency evaluation device of claim 177 wherein bills whose denomination have been determined by the discriminating unit are delivered to a first output receptacle and wherein suspect bills are directed to the other output receptacle.

179. The currency evaluation device of claim 178 wherein the processor is adapted to cause the transport mechanism to halt before a suspect bill has been delivered to the second output receptacle.

180. The currency evaluation device of claim 179 wherein the processor is adapted to cause the transport mechanism to halt with the suspect bill being located at an identifiable location within the transport mechanism.

181. The currency evaluation device of claim 178 wherein the processor is adapted to cause the transport mechanism to halt after a suspect bill has been delivered to the second output receptacle.

182. The currency evaluation device of claim 181 wherein the processor is adapted to cause the transport mechanism to halt with the suspect bill being positioned at an identifiable location in the second output receptacle.

183. The currency evaluation device of claim 182 wherein the processor is adapted to cause the transport mechanism to halt with the suspect bill being the last bill transported to the second output receptacle, wherein the non-piece count criterion is a bill being suspect.

184. The currency evaluation device of claim 164 wherein the criterion is the discriminating unit determining the denomination of the bill, a bill failing to have its denomination determined by the discriminating unit being termed a no call bill, and wherein the processor is adapted to cause the transport mechanism to halt with a no call bill as the last bill in one of the output receptacles.

185. The currency evaluation device of claim 164 wherein the discrimination unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the criterion is a bill being a stranger bill, and wherein the processor is adapted to cause the transport mechanism to halt with a stranger bill as the last bill in one of the output receptacles.



186. The currency evaluation device of claim 164 wherein the criterion is a bill being suspect, and wherein the processor is adapted to cause the transport mechanism to halt with a suspect bill as the last bill in one of the output receptacles.

187. The currency evaluation device of claim 164 wherein a bill failing to have its denomination determined by the discriminating unit being termed a no call bill, and wherein the discriminating unit is further adapted to determine whether a bill is suspect.

188. The currency evaluation device of claim 187 wherein the processor is adapted to cause the transport mechanism to halt when a bill is determined to be suspect by the discriminating unit, a bill determined to be suspect by the discriminating unit being termed a suspect bill.

189. The currency evaluation device of claim 188 wherein bills whose denomination have been determined by the discriminating unit and suspect bills are delivered to a first output receptacle and wherein no call bills are delivered to the other output receptacle.

190. The currency evaluation device of claim 189 wherein the discrimination unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the discriminating unit further is adapted to determine whether bills are stranger bills, and wherein stranger bills are delivered to the second output receptacle.

191. The currency evaluation device of claim 190 wherein the processor is adapted to cause the transport mechanism to halt after a no call bill or a stranger bill has been delivered to the second output receptacle.

192. The currency evaluation device of claim 191 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill or the stranger bill being the last bill transported to the second output receptacle.

193. The currency evaluation device of claim 190 wherein the processor is adapted to cause the transport mechanism not to halt after a no call bill or a stranger bill has been delivered to the second output receptacle.

194. The currency evaluation device of claim 193 wherein the processor is adapted to cause the transport mechanism to halt after a suspect bill has been delivered to an output receptacle.

195. The currency evaluation device of claim 187 wherein bills whose denomination have been determined by the discriminating unit are delivered to a first output receptacle and wherein no call bills are delivered to a second output receptacle.

196. The currency evaluation device of claim 195 wherein the processor is adapted to cause the transport mechanism to halt after a no call bill has been delivered to the second output receptacle.

197. The currency evaluation device of claim 164 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

198. The currency evaluation device of claim 164 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the discriminating unit is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

199. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills to be evaluated;

exactly two output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

a detector positioned along the transport path between the input receptacle and the output receptacles, the detector being adapted to generate an output signal; and

a processor adapted to receive the output signal and programmed to count and denominate the bills and programmed to determine whether the bills meet or fail to meet a non-piece count related criterion, the processor being programmed to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill, the processor being adapted to cause the transport mechanism to halt with a flagged bill being positioned as the last bill in one of the output receptacles.

200. The currency evaluation device of claim 199 wherein the input receptacle is adapted to receive and the processor is adapted to denominate bills of a plurality of United States denominations.

201. The currency evaluation device of claim 199 wherein the processor is adapted to denominate currency bills independently of the size of the bills.

202. The currency evaluation device of claim 199 wherein the processor is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

203. The currency evaluation device of claim 199 wherein the processor is adapted to denominate currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the processor is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

204. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills to be evaluated;

exactly two output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

a discriminating unit adapted to count and denominate the bills, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles; and

a processor programmed to flag bills meeting or failing to meet any of a plurality of non-piece count related criteria; wherein the processor is adapted to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet at least one of the criteria, the at least one criteria being termed a halting criterion, a bill meeting or failing to meet any of the criteria being termed a flagged bill, the processor being adapted to cause the transport mechanism to halt with a bill satisfying the halting criteria being positioned as the last bill in one of the output receptacles.

205. The currency evaluation device of claim 204 wherein the input receptacle is adapted to receive and the discriminating unit is adapted to denominate bills of a plurality of United States denominations.

206. The currency evaluation device of claim 204 wherein the discriminating unit is adapted to denominate currency bills independently of the size of the bills.

207. The currency evaluation device of claim 204 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

208. The currency evaluation device of claim 204 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, genuine bills of the

plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the discriminating unit is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

209. A compact, high-speed United States currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of United States currency bills of a plurality of denominations to be evaluated;

exactly two output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the output receptacles at a rate of at least 800 bills per minute;

a discriminating unit adapted to count and denominate the bills including United States bills of a plurality of denominations at a rate of at least 800 bills per minute, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles; and

a processor programmed to flag bills meeting or failing to meet any of certain non-piece count related criteria, a bill meeting or failing to meet any of the criteria being termed a flagged bill, the processor being adapted to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet at least one of the criteria.

210. The currency evaluation device of claim 209 wherein the device is adapted to deliver and at least one output receptacle is adapted to receive denominated bills of more than one denomination.

211. The currency evaluation device of claim 209 wherein the device is adapted to deliver and only one output receptacle is adapted to receive denominated bills of more than one denomination.

212. The currency evaluation device of claim 209 wherein the processor is adapted to cause the transport mechanism to halt with a bill satisfying the at least one criterion being positioned as the last bill in one of the output receptacles.

213. The currency evaluation device of claim 209 wherein the certain criteria include a criterion of the discriminating unit determining the denomination of a bill, a bill failing to meet the criterion of having its denomination determined by the discriminating unit being termed a no call bill, the processor being programmed to flag no call bills.

214. The currency evaluation device of claim 213 wherein the discriminating unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the certain criteria include the discriminating unit determining a bill is a stranger bill and wherein the processor is programmed to flag stranger bills.

215. The currency evaluation device of claim 214 wherein the discriminating unit is further adapted to determine whether a bill is a suspect bill and wherein the certain criteria include the discriminating unit determining a bill is a suspect bill and wherein the processor is programmed to flag suspect bills.

216. The currency evaluation device of claim 215 wherein the two output receptacles consist of a first output receptacle and a second output receptacle, and wherein stranger bills and no call bills are directed to the first output receptacle and suspect bills are directed to the second output receptacle.

217. The currency evaluation device of claim 216 wherein the processor is adapted to cause the transport mechanism to halt when a no call bill or a stranger bill is delivered to the first output receptacle.

218. The currency evaluation device of claim 216 wherein the processor is adapted to cause the transport mechanism not to halt when a no call bill or a stranger bill is delivered to the first output receptacle.

219. The currency evaluation device of claim 209 wherein the discriminating unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the certain criteria include the discriminating unit determining a bill to be a stranger bill, and wherein the processor is programmed to flag stranger bills.

220. The currency evaluation device of claim 209 wherein the discriminating unit is further adapted to determine whether a bill is suspect and wherein the certain criteria include the discriminating unit determining whether a bill is suspect, a bill determined to be suspect being termed a suspect bill and wherein the processor is programmed to flag suspect bills.

221. The currency evaluation device of claim 209 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

222. The currency evaluation device of claim 209 wherein the processor is adapted to cause the transport mechanism to halt with a bill meeting or failing to meet the at least one criterion being positioned at an identifiable location in one of the output receptacles.

223. The currency evaluation device of claim 209 wherein the processor is adapted to cause the transport mechanism to halt with a bill meeting or failing to meet the at least one criterion being located at an identifiable location within the transport mechanism.

224. The currency evaluation device of claim 209 wherein the processor is adapted to cause the transport mechanism to halt with a bill meeting or failing to meet the at least one criterion being located at a predetermined position.

225. The currency evaluation device of claim 209 wherein the certain criteria include the discriminating unit determining the denomination of a bill and wherein the processor is adapted to cause the transport mechanism to halt when a bill fails to meet a criterion of having its denomination determined by the discriminating unit, a bill failing to meet the criterion of having its denomination determined by the discriminating unit being termed a no call bill.

226. The currency evaluation device of claim 225 wherein the processor is adapted to cause the transport mechanism to halt with a no call bill being positioned at an identifiable location in one of the output receptacles.

227. The currency evaluation device of claim 225 wherein the processor is adapted to cause the transport mechanism to halt with a no call bill being located at a predetermined position.

228. The currency evaluation device of claim 225 wherein bills meeting the certain criteria of having their denomination determined by the discriminating unit are delivered to a first output receptacle and wherein no call bills are directed to the other output receptacle.

229. The currency evaluation device of claim 228 wherein the processor is adapted to cause the transport mechanism to halt before a no call bill has been delivered to the other output receptacle.

230. The currency evaluation device of claim 228 wherein the processor is adapted to cause the transport mechanism to halt after a no call bill has been delivered to the other output receptacle.

231. The currency evaluation device of claim 230 wherein the processor is adapted to cause the transport mechanism to halt with a no call bill being positioned at an identifiable location in the other output receptacle.



232. The currency evaluation device of claim 231 wherein the processor is adapted to cause the transport mechanism to halt with a no call bill being the last bill transported to the other output receptacle.

233. The currency evaluation device of claim 209 wherein the discriminating unit is further adapted to determine whether bills are suspect and wherein the certain criteria include the discriminating unit determining a bill is suspect and wherein the processor is adapted to cause the transport mechanism to halt when a bill meets a criterion of being determined to be suspect by the discriminating unit, a bill being determined to be suspect being termed a suspect bill.

234. The currency evaluation device of claim 233 wherein bills whose denomination have been determined by the discriminating unit are delivered to a first output receptacle and wherein suspect bills are directed to the other output receptacle.

235. The currency evaluation device of claim 234 wherein the processor is adapted to cause the transport mechanism to halt after a suspect bill has been delivered to the other output receptacle.

236. The currency evaluation device of claim 235 wherein the processor is adapted to cause the transport mechanism to halt with the suspect bill being positioned at an identifiable location in the other output receptacle.

237. The currency evaluation device of claim 236 wherein the processor is adapted to cause the transport mechanism to halt with the suspect bill being the last bill transported to the other output receptacle.

238. The currency evaluation device of claim 234 wherein bills whose denomination have not been determined by the discriminating unit are also delivered to the other output receptacle.

239. The currency evaluation device of claim 238 wherein the processor is adapted not to halt the transport mechanism in response to the denomination of a bill not being determined.

240. The currency evaluation device of claim 234 wherein bills whose denomination have not been determined by the discriminating unit are directed to the first output receptacle.

241. The currency evaluation device of claim 209 wherein the certain criteria include the discriminating unit determining the denomination of a bill and wherein the processor is adapted to cause the transport mechanism to halt when a bill fails to meet a criterion of having its denomination determined by the discriminating unit, a bill failing to meet a criterion of having its denomination determined by the discriminating unit being termed a no call bill, and wherein the discriminating unit further determines whether bills are suspect.

242. The currency evaluation device of claim 241 wherein the processor is also adapted to cause the transport mechanism to halt when a bill meets a second criterion of being determined to be suspect by the discriminating unit.

243. The currency evaluation device of claim 242 wherein bills whose denomination have been determined by the discriminating unit are delivered to a first output receptacle and wherein bills determined by the discriminating unit to be suspect and bills whose denomination have not been determined by the discriminating unit are directed to the other output receptacle.

244. The currency evaluation device of claim 243 wherein the processor is adapted to cause the transport mechanism to halt after a no call bill or a suspect bill has been delivered to the other output receptacle.

245. The currency evaluation device of claim 244 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill or the suspect bill being the last bill transported to the other output receptacle.

246. The currency evaluation device of claim 241 wherein bills whose denomination have been determined by the discriminating unit are delivered to a first output receptacle and wherein bills whose denomination have not been determined by the discriminating unit are directed to the other output receptacle.

247. The currency evaluation device of claim 246 wherein bills determined by the discriminating unit to be suspect are also delivered to the other output receptacle.

248. The currency evaluation device of claim 246 wherein bills determined by the discriminating unit to be suspect are delivered to the first output receptacle.

249. The currency evaluation device of claim 209 wherein genuine bills of the plurality of United States denominations having a plurality of images associated therewith, the plurality of images defining the plurality of United States denominations and wherein the discriminating unit is adapted to distinguish among the plurality of United States denominations by scanning the image associated with each of the bills.

250. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- an input receptacle adapted to receive a stack of bills to be evaluated;

- exactly two output receptacles adapted to receive the bills after the bills have been evaluated;

- a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the output receptacles;

- a discriminating unit adapted to count and denominate the bills including bills of a plurality of denominations, the discriminating unit including at least one detector positioned along the transport path between the input receptacle and the output receptacles; and

- means for flagging a bill when the denomination of the bill is not determined by the discriminating unit, wherein the means for flagging is adapted to cause the transport mechanism to halt when a bill whose denomination has not been determined is encountered;

wherein the device is adapted to transport bills which have been denominated including bills of a plurality of denominations to a first output receptacle.

251. The currency evaluation device of claim 250 wherein the currency bills comprise United States currency and the discriminating unit is adapted to denominate United States currency bills of a plurality of denominations.

252. The currency evaluation device of claim 250 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

253. The currency evaluation device of claim 250 wherein the currency bills of a plurality of denominations include bills of at least two of the denominations having the same dimensions.

254. The currency evaluation device of claim 250 wherein the means for flagging is adapted to cause the transport mechanism to halt with the bill whose denomination has not been determined being the last bill transported to one of the output receptacles.

255. The currency evaluation device of claim 250 wherein the device is adapted to transport bills which have not been denominated to a second output receptacle, the second output receptacle being different than the first output receptacle receiving bills which have been denominated.

256. The currency evaluation device of claim 255 wherein the first and second output receptacles have a stacking mechanism associated therewith and adapted to re-stack denominated bills in the first output receptacle and re-stack bills which have not been denominated in the second output receptacle.

257. The currency evaluation device of claim 250 wherein the detector of the discriminating unit includes a stationary optical scanning head adapted to scan at least a preselected segment of each bill transported between the input and output receptacles by the transport

mechanism, and adapted to produce an output signal representing the scanned image and wherein the discriminating unit includes signal processing means adapted to receive the output signal and determine the denomination of each scanned bill.

258. The currency evaluation device of claim 250 wherein the transport mechanism is adapted to transport bills at a rate of at least about 800 bills per minute.

259. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills to be evaluated;

exactly two output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the output receptacles;

a discriminating unit including at least one detector positioned along the transport path between the input receptacle and output receptacle, the discriminating unit being adapted to count and determine the denomination of the bills and determine whether the bills are suspect; and

means for flagging a bill when the bill is determined to be suspect by the discriminating unit; wherein the means for flagging is adapted to cause the transport mechanism to halt when the discriminating unit determines that a bill is suspect.

260. The currency evaluation device of claim 259 wherein the currency bills comprise United States currency and the discriminating unit is adapted to denominate United States currency bills of a plurality of denominations.

261. The currency evaluation device of claim 259 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

262. The currency evaluation device of claim 259 wherein the means for flagging is adapted to cause the transport mechanism to halt when the discriminating unit determines that a

bill is suspect with the bill which is determined to be suspect being the last bill transported to one of the output receptacles.

263. The currency evaluation device of claim 259 wherein the detector of the discriminating unit includes a stationary optical scanning head adapted to scan at least a preselected segment of each bill transported between the input and output receptacles by the transport mechanism and produce an output signal representing the scanned image, and wherein the discriminating unit includes a processor adapted to receive the output signal and determine the denomination of each scanned bill.

264. A high-speed, United States currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- an input receptacle adapted to receive a stack of bills to be evaluated;

- exactly two output receptacles adapted to receive the bills after the bills have been evaluated, at least one of the output receptacles being adapted to receive more than one denomination of bills;

- a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the output receptacles at a rate in excess of 800 bills per minute;

- a discriminating unit adapted to count and denominate the bills including United States currency bills of a plurality of denominations at a rate in excess of 800 bills per minute, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles;

- a processor programmed to flag bills meeting or failing to meet any of certain non-piece count criteria, a bill meeting or failing to meet any of the criteria being termed a flagged bill; wherein the processor is adapted to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet a given one or ones of the criteria; and

- wherein the processor is adapted to cause the transport mechanism to halt with a flagged bill meeting or failing to meet at least a given set of the criteria being positioned in one of the output receptacles.

265. The currency evaluation device of claim 264 wherein the processor is adapted to cause the transport mechanism to halt with a flagged bill being positioned as the last bill in one of the output receptacles.

266. The currency evaluation device of claim 264 wherein the processor is adapted to cause the transport mechanism to halt with a flagged bill being located at a predetermined position.

267. The currency evaluation device of claim 264 wherein the certain criteria include the discriminating unit determining the denomination of a bill, a bill failing to meet a criterion of having its denomination determined by the discriminating unit being termed a no call bill.

268. The currency evaluation device of claim 267 wherein the discriminating unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the certain criteria include the discriminating unit determining a bill is a stranger bill.

269. The currency evaluation device of claim 268 wherein no call bills are delivered to a first output receptacle, and wherein stranger bills are delivered to a second output receptacle.

270. The currency evaluation device of claim 268 wherein the discriminating unit is further adapted to determine whether a bill is suspect and wherein the certain criteria include the discriminating unit determining a bill is suspect, a bill determined to be suspect being termed a suspect bill.

271. The currency evaluation device of claim 270 wherein the output receptacles include a reject receptacle, wherein no call bills and stranger bills are directed to the reject receptacle, and suspect bills are directed to other one of the output receptacles.

272. The currency evaluation device of claim 271 wherein the processor is adapted to cause the transport mechanism to halt when a bill is directed to the reject receptacle.

273. The currency evaluation device of claim 271 wherein the processor is adapted to cause the transport mechanism not to halt when a bill is directed to the reject receptacle.

274. The currency evaluation device of claim 264 wherein the output receptacles include a reject receptacle, and wherein the processor is adapted to cause the transport mechanism to deliver flagged bills to the reject receptacle.

275. The currency evaluation device of claim 264 wherein the discriminating unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the certain criteria include the discriminating unit determining a bill is a stranger bill.

276. The currency evaluation device of claim 264 wherein the discriminating unit is further adapted to determine whether a bill is suspect and wherein the certain criteria include the discriminating unit determining a bill is suspect, a bill determined to be suspect being termed a suspect bill.

277. The currency evaluation device of claim 264 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

278. The currency evaluation device of claim 264 wherein bills of at least two of the denominations have the same dimensions.

279. The currency evaluation device of claim 264 wherein genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the discriminating unit is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.



280. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

exactly two output receptacles positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacles to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

a discriminating unit comprising a processor and at least one detector positioned along the transport path between the input receptacle and the output receptacles, the detector being adapted to generate a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor being adapted to receive the characteristic information output signal and generate a denomination signal in response thereto; and

a flagging device comprising a processor and an encoder linked to the transport mechanism, the encoder being adapted to produce tracking signals in response to the physical movement of the bills, the processor being adapted to generate a no call signal when the denomination of a bill is not determined by the processor; wherein the flagging device is adapted to generate a stopping signal in response to the no call signal and wherein the transport drive motor is adapted to stop in response to the stopping signal; and

wherein the device is adapted to transport bills which have been denominated to a first output receptacle.

281. The currency evaluation device of claim 280 wherein the currency bills comprise United States currency and the discriminating unit is adapted to denominate United States currency bills of a plurality of denominations.

282. The currency evaluation device of claim 280 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

283. The currency evaluation device of claim 280 wherein the flagging device is adapted to cause the transport mechanism to stop with the bill whose denomination has not been determined being the last bill transported to one of the output receptacles.

284. The currency evaluation device of claim 280 wherein the device is adapted to transport bills which have not been denominated to the other output receptacle.

285. The currency evaluation device of claim 284 wherein the first and second output receptacles have a stacking mechanism associated therewith and which is adapted to re-stack denominated bills in the first output receptacle and re-stack bills which have not been denominated in the second output receptacle.

286. The currency evaluation device of claim 280 further comprising a memory and wherein the processor is adapted to generate a scanned pattern from each of the bills based on the characteristic information output signal and determine the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in the memory.

287. The currency evaluation device of claim 286 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

288. The currency evaluation device of claim 287 wherein the processor is adapted to correlate the scanned pattern generated from the bill with master patterns associated with different denominations of bills and determine the denomination of the bill if the scanned pattern sufficiently correlates with one of the master patterns.

289. The currency evaluation device of claim 280 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

290. The currency evaluation device of claim 280 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the discriminating unit is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

291. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- an input receptacle positioned to receive a stack of bills to be evaluated;

- exactly two output receptacles positioned to receive the bills after the bills have been evaluated;

- a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

- a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor being adapted to receive the characteristic information output signal and generate a denomination signal in response thereto; the processor also being adapted to generate a suspect signal when a bill is determined to be suspect by the processor, and

- a flagging device comprising a processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills; wherein the flagging device is adapted to generate a stopping signal in response to the suspect signal and wherein the transport drive motor is adapted to stop in response to the stopping signal.

292. The currency evaluation device of claim 291 wherein the input receptacle is adapted to receive and the processor is adapted to denominate bills of a plurality of United States denominations.

293. The currency evaluation device of claim 291 wherein the processor is adapted to denominate currency bills independently of the size of the bills.

294. The currency evaluation device of claim 291 wherein the processor is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

295. The currency evaluation device of claim 291 wherein the processor is adapted to denominate currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the processor is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

296. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- an input receptacle adapted to receive a stack of bills to be evaluated;
- exactly two output receptacles adapted to receive the bills after the bills have been evaluated;

- a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the output receptacles;

- a discriminating unit adapted to count and denominate the bills, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles; and

- a processor programmed to cause the transport mechanism to halt in a predetermined manner in response to a determination that a bill meets a stranger bill criterion and in response to a determination that a bill meets a no call bill criterion, and wherein a bill which meets the stranger bill criterion is termed a stranger bill, and wherein a bill which meets the no call bill criterion is termed a no call bill.

297. The currency evaluation device of claim 296 wherein the currency bills comprise United States currency and the discriminating unit is adapted to denominate United States currency bills of a plurality of denominations.

298. The currency evaluation device of claim 296 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

299. The currency evaluation device of claim 296 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate in excess of 800 bills per minute.

300. The currency evaluation device of claim 296 wherein the device is adapted to permit manual removal of a no call or a stranger bill after the transport mechanism has halted.

301. The currency evaluation device of claim 300 further comprising a key adapted to restart the operation of the device after the transport mechanism has halted.

302. The currency evaluation device of claim 296 wherein the processor is adapted to cause the transport mechanism to halt with a bill meeting a no call bill criterion or a stranger bill criterion being positioned in one of the output receptacles.

303. The currency evaluation device of claim 296 wherein the processor is adapted to cause the transport to halt with a bill meeting a no call bill criterion or a stranger bill criterion being positioned as the last bill in one of the output receptacles.

304. The currency evaluation device of claim 296 wherein the processor is adapted to cause the transport mechanism to halt with a bill meeting a no call bill criterion or a stranger bill criterion being located at a predetermined position.

305. The currency evaluation device of claim 296 wherein at least one of the output receptacles is adapted to receive denominated currency bills of more than one denomination.

306. The currency evaluation device of claim 296 wherein the output receptacles include a reject receptacle, and wherein the processor is adapted to cause the transport mechanism to deliver no call and stranger bills to the reject receptacle.

307. The currency evaluation device of claim 296 wherein the discriminating unit is further adapted to determine whether bills are suspect and wherein one of a criterion is the discriminating unit determining a bill is suspect, a bill determined to be suspect being termed a suspect bill.

308. The currency evaluation device of claim 307 wherein the output receptacles include a reject receptacle, and wherein stranger and no call bills are delivered to the reject receptacle and wherein suspect bills are delivered to the other one of the output receptacles.

309. The currency evaluation device of claim 308 wherein the processor is adapted to cause the transport mechanism to halt when a bill meeting the no call criterion or the stranger criterion is delivered to the reject receptacle.

310. The currency evaluation device of claim 296 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

311. The currency evaluation device of claim 296 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the discriminating unit is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

**PATENT**

**CUMM:262 (47171-00262)**

**METHOD AND APPARATUS FOR DOCUMENT PROCESSING**

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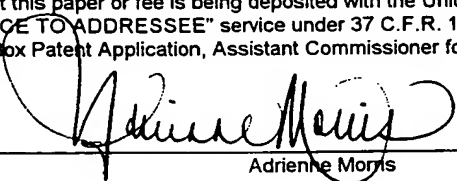
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**EXPRESS MAIL MAILING LABEL**

NUMBER: EL566135792US

DATE OF DEPOSIT: April 3, 2000

I hereby certify that this paper or fee is being deposited with the United States Postal Service "EXPRESS MAIL POST OFFICE TO ADDRESSEE" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to: Box Patent Application, Assistant Commissioner for Patents, Washington D.C. 20231.



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## BACKGROUND OF THE INVENTION

### **Cross-Reference to Related Applications**

This application is a continuation of copending U.S. Patent Application Serial No. 08/864,423 filed May 28, 1997 entitled "Method and Apparatus for Document Processing", which is hereby incorporated by reference in its entirety.

U.S. Patent Application Serial No. 08/864,423 claims the benefit of Provisional Patent Application Serial No. 60/018,563 filed May 29, 1996 entitled "Method and Apparatus for Document Identification and Authentication", 60/034,954 filed January 16, 1997 entitled "Method and Apparatus for Document Processing", and 60/038,340 filed February 27, 1997 entitled "Method and Apparatus for Document Processing."

U.S. Patent Application Serial No. 08/864,423 is a continuation-in-part and further claims the benefit of U.S. Patent Application Serial No. 08/800,053, which was issued on November 30, 1999 as U.S. Patent No. 5,992,601 entitled "Method and Apparatus for Document Identification and Authentication" and Serial No. 08/573,392, which was issued on August 4, 1998 as U.S. Patent No. 5,790,697 entitled "Method and Apparatus for Discriminating and Counting Documents."

U.S. States Patent Application Serial No. 08/800,053 claims the benefit of Provisional Patent Application Serial Nos. 60/011,688 filed February 15, 1996, now abandoned, and 60/018,563 filed May 29, 1996.

### **Field of the Invention**

The present invention relates, in general, to document processing. More specifically, the present invention relates to a method and apparatus for document discrimination, authentication, and/or sorting.

### **Background**

A variety of techniques and apparatus have been used in automated currency handling systems. Traditionally, these currency handling systems utilized a complex series of belts, pulleys, wheels and rollers to guide a currency bill through a complicated pathway having many twists and turns to pass the currency bill through the discriminating and/or authenticating sensors and to deliver the bills to an assigned output receptacle. These



complicated pathways have sometimes led to jams of the currency bills which are difficult to clear.

Therefore, a need exists for a transport mechanism that reduces currency jams and is more accessible when clearing currency jams.

There is also a need for a currency evaluation device that can distinguish bills based on a number of criteria and that is flexible in permitting the operator of the device to specify which criteria are to be used to distinguish bills and how bills meeting or failing to meet various criteria are to be handled. There is also a need for a currency evaluation device having an input/output means that is simply to operate, flexible, and customizable.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method and apparatus for document transport which reduces currency jams and is more accessible when clearing currency jams. Briefly, according to one embodiment, a method and apparatus for transporting a currency bill to be evaluated by a discrimination and/or authentication apparatus is provided. A transport mechanism includes a pair of substantially smooth opposing plates. These plates are substantially free of surface features. The smooth plates comprise a transport plate and a follower plate and define a currency pathway there between. A plurality of transport rolls protrude through apertures in the transport plate so as to frictionally engage the bills and actively advance the bills through the currency pathway. Furthermore, the follower plate is preferably mounted on a hinged module so that it may rotate out and away from the transport plate to allow easy access to the currency pathway.

In one embodiment, a transport mechanism includes a transport plate which defines in a substantially planar transport path between an evaluating mechanism and a plurality of output receptacles. The transport mechanism may include a follower plate that is substantially smooth and without surface features. The follower plate is positioned substantially parallel and in spaced relation to the opposing transport plate so as to define a currency pathway there between.

According to another embodiment, a currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack is provided. The device has an input receptacle for receiving a stack of bills to be evaluated and a number of output receptacles for receiving the bills after the bills have been evaluated. A transport mechanism transports the bills, one at a time, from the input receptacle to one of the output receptacles

along a transport path. A discriminating unit evaluates the bills including determining certain information concerning the bills. A control panel includes a touch screen for displaying the information concerning the bills and for receiving operational instructions from a user. A controller coupled to the touch screen and the discriminating unit causes the discriminating unit to operate in a number of modes in response to the operational instructions from the user. In one embodiment, the evaluation device has exactly two output receptacles.

According to another embodiment, a currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack is provided wherein the device flags bills meeting or failing to meet certain criteria. A bill may be flagged, for example, by presenting the bill in one of the output pockets (delivering the bill to one of the pockets and suspending the operation of the device) or by off-sorting the bill to a different output pocket and continuing to process other bills. According to one embodiment the currency evaluation device has two output receptacles for receiving bills after they have been evaluated.

According to another embodiment a currency evaluation device has a routing interface. The routing interface has a data retrieval device such as a touch screen that receives information from a user of the evaluation device specifying into which output receptacle bills are to be delivered based on one or more criteria such as, *e.g.*, a bill being a stranger.

According to another embodiment a currency evaluation device has a flagging control interface. The flagging control interface has a data retrieval device such as a touch screen that receives information from a user of the evaluation device specifying whether the evaluation device should suspend its operation based on the detection of a bill meeting or failing to meet one or more criteria such as, *e.g.*, a bill being a no call bill.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

Other objects and advantages of the invention will become apparent upon reading the following detailed description in conjunction with the drawings in which:

FIG. 1a is a perspective view of a multi-pocket document evaluation device according to one embodiment of the present invention;

FIG. 1b is another perspective view of a multi-pocket document evaluation device according to one embodiment of the present invention;

FIG. 2 is a side view of an evaluation device depicting various transport rolls in side elevation according to one embodiment of the present invention;

FIG. 3 is a side view depicting a stripping wheel according to one embodiment;

FIG. 4 is a sectional side view taken across a currency pathway depicting a bill in the region of an evaluating mechanism according to one embodiment of the present invention;

FIG. 5 is a sectional bottom view depicting a portion of a transport plate illustrating H-shaped leaf springs in conjunction with passive rolls according to one embodiment;

5 FIG. 6 is a top view of a machine depicting various shafts according to one embodiment of the present invention;

FIG. 7a is a sectional side view of a transport plate according to one embodiment of the present invention;

10 FIG. 7b is a front view of a first region of a transport plate according to one embodiment of the present invention;

FIG. 7c is a sectional side view of the first region of a transport plate depicted in FIG. 7b;

FIG. 7d is a front view of a second region of a transport plate according to one embodiment of the present invention;

15 FIG. 7e is a sectional side view of the second region of a transport plate depicted in FIG. 7d;

FIG. 8a is a sectional side view taken across a currency pathway depicting a bill passing below a first follower plate according to one embodiment of the present invention;

20 FIG. 8b is a sectional side view of a first follower plate according to one embodiment of the present invention;

FIG. 8c is a front view of the first follower plate depicted in FIG. 8b;

FIG. 9a is a sectional side view taken across a currency pathway depicting a bill passing below a second follower plate according to one embodiment of the present invention;

25 FIG. 9b is a sectional side view of a second follower plate according to one embodiment of the present invention;

FIG. 9c is a front view of the second follower plate depicted in FIG. 9b;

FIG. 10a is a side view depicting an evaluation device in an open position according to one embodiment of the present invention;

30 FIG. 10b is a side view depicting an evaluation device in an open position according to one embodiment of the present invention;

FIG. 11a is a front view of a transport plate according to one embodiment of the present invention;

FIG. 11b is a sectional side view of a transport plate according to one embodiment of the present invention;

FIG. 12a is a side view of an evaluation device having three output receptacles depicting various transport rolls in side elevation according to one embodiment of the present invention;

FIG. 12b is a side view of an evaluation device having four output receptacles depicting various transport rolls in side elevation according to one embodiment of the present invention;

FIG. 12c is a side view of an evaluation device having six output receptacles depicting various transport rolls in side elevation according to one embodiment of the present invention;

FIG. 13 is a sectional view taken approximately through the center of another embodiment of a currency discriminating machine having two output receptacles showing the various transport rolls in side elevation;

FIG. 14a is a sectional view of a scanhead according to one embodiment;

FIG. 14b is an end elevation of a upper support member which includes an upper scanhead and a sectional view of a lower support member mounted beneath a upper support member according to one embodiment;

FIG. 15 is a top plan view of an upper support member which includes an upper scanhead according to one embodiment;

FIG. 16 is a bottom plan view of an upper support member which includes an upper scanhead according to one embodiment;

FIG. 17 is a functional block diagram illustrating a document authenticator and discriminator according to one embodiment of the present invention;

FIG. 18 is a functional block diagram illustrating a two-pocket document authenticator and discriminator according to one embodiment of the present invention;

FIG. 19 is a front view of a control panel according to one embodiment of the present invention;

FIG. 20 is a touch screen according to one embodiment of the present invention;

FIGs. 21-33 illustrate various touch screen displays according to various embodiments of the present invention;

FIG. 34 is a numerical keypad according to one embodiment of the present invention;

FIGs. 35-40 illustrate examples of operating parameters selection screens; and

FIGs. 41 and 42 are tables summarizing various embodiments of several operating modes.

### DETAILED DESCRIPTION OF THE EMBODIMENTS

The transport mechanism of the present invention may be used and incorporated in an apparatus which sorts, analyzes, transports, evaluates, authenticates, discriminates, counts or otherwise processes documents. In one embodiment, a transport mechanism of the present invention is incorporated in an evaluation apparatus for discriminating and/or authenticating currency bills. However, the transport mechanism of the present invention may be employed in conjunction with the processing of other documents such as, for example, stock certificates, bonds, postage stamps and food stamps.

FIGs. 1a and 1b depict an exterior perspective view and FIG. 2 is a side view of a multi-pocket document evaluation device 10 such as a currency discriminator according to one embodiment of the present invention. According to one embodiment the currency discriminator 10 is compact having a height (H) of about 17 ½ inches (44.5 cm), width (W) of about 13 ½ inches (34.3 cm), and a depth (D) of about 15 inches (38.1 cm) and weighs approximately 35 lbs. (16 kg). The evaluation device 10 may be rested upon a tabletop.

In FIGs. 1a, 1b, and 2, currency bills are fed, one by one, from a stack of currency bills placed in an input receptacle 12 into a transport mechanism. The transport mechanism includes a transport plate or guide plate 240 for guiding currency bills to one of a plurality of output receptacles 217a and 217b. Before reaching the output receptacles 217a, 217b a bill can be, for example, evaluated, analyzed, authenticated, discriminated, counted and/or otherwise processed. The results of the above process or processes may be used to determine to which output receptacle 217a, 217b a bill is directed. In one embodiment, documents such as currency bills are transported, scanned, and identified at a rate equal to or greater than 600 bills per minute. In another embodiment, documents such as currency bills are transported, scanned, and identified at a rate equal to or greater than 800 bills per minute. In another embodiment, documents such as currency bills are transported, scanned, and identified at a rate equal to or greater than 1000 bills per minute. For currency bills, the identification may include the determination of the denomination of each bill.

The input receptacle 12 for receiving a stack of bills to be processed is formed by downwardly sloping and converging walls 205 and 206 (see FIG. 2) formed by a pair of removable covers (not shown) which snap onto a frame. The converging wall 206 supports a

removable hopper (not shown) that includes vertically disposed side walls (not shown). One embodiment of an input receptacle is described and illustrated in more detail in United States patent application Serial No. 08/450,505 filed May 26, 1995, entitled "Method and Apparatus for Discriminating and Counting Documents" which is incorporated by reference in its entirety. The currency discriminator 10 in FIGs. 1a and 1b has a touch panel display 15 in one embodiment of the present invention which displays appropriate "functional" keys when appropriate. The touch panel display 15 simplifies the operation of the multi-pocket currency discriminator 10. The touch panel display 15 may be a full graphics display. Alternatively or additionally physical keys or buttons may be employed.

From the input receptacle 12, the currency bills are moved in seriatim from the bottom of a stack of bills along a curved guideway 211 (shown in FIG. 2) which receives bills moving downwardly and rearwardly and changes the direction of travel to a forward direction. A stripping wheel 220 (shown in FIG. 3) mounted on a stripping wheel shaft 219 aids in feeding the bills to the curved guideway 211. The curvature of the guideway 211 corresponds substantially to the curved periphery of a drive roll 223 so as to form a narrow passageway for the bills along the rear side of the drive roll 223. An exit end of the curved guideway 211 directs the bills onto the transport plate 240 which carries the bills through an evaluation section and to one of the output receptacles 217a, 217b.

Stacking of the bills in one embodiment is accomplished by a pair of driven stacking wheels 212a and 213a for the first or upper output receptacle 217a and by a pair of stacking wheels 212b and 213b for the second or bottom output receptacle 217b. The stacker wheels 212a,b and 213a,b are supported for rotational movement about respective shafts 215a,b journaled on a rigid frame and driven by a motor (not shown). Flexible blades of the stacker wheels 212a and 213a deliver the bills onto a forward end of a stacker plate 214a. Similarly, the flexible blades of the stacker wheels 212b and 213b deliver the bills onto a forward end of a stacker plate 214b.

A diverter 260 directs the bills to either the first or second output receptacle 217a, 217b. When the diverter is in a lower position, bills are directed to the first output receptacle 217a. When the diverter 260 is in an upper position, bills proceed in the direction of the second output receptacle 217b.

Referring to FIG. 4, at a lower end of the curved guideway 211, a bill 20 being transported by the drive roll 223 engages the transport plate 240. Bills are positively driven along the transport plate 240 by means of a transport roll arrangement comprising both driven

and passive rolls. A pair of O-rings 244 and 245 fit into grooves formed in a drive roll 241 and in the drive roll 223. The pair of O-rings 244 and 245 engage the bill 20 continuously between the two driven upper rolls 223 and 241 and assist in holding the bill 20 flat against the transport plate 240. Such an embodiment aids to the performance of the sensors of the evaluation region 247. Rolls 223 and 241 are driven by a motor (not shown) via a belt 21. Such an arrangement is illustrated in more detail in United States patent application Serial No. 08/450,505 referred to above.

Passive rolls 250, 251 are mounted on an underside of the transport plate 240 in such a manner as to be freewheeling about their respective axes 254 and 255 and biased into counter-rotating contact with their corresponding driven upper rolls 223 and 241. The passive rolls 250 and 251 preferably have high-friction rubber surfaces and are biased into contact with their respective driven upper rolls 223 and 241 by means of a pair of H-shaped leaf springs 252 and 253 (see FIG. 5). The central portion of each leaf spring is fastened to the transport plate 240, which is fastened rigidly to the machine frame, so that the relatively stiff arms of the H-shaped springs exert a constant biasing pressure against the passive rolls 250 and 251 and push them against the corresponding upper rolls 223 and 241.

Referring back to FIG. 4, the driven and passive transport rolls are preferably coplanar with a flat upper surface of the transport plate 240 so that currency bills can be positively driven along the top surface of the plate in a flat manner. To minimize the possibility of bill skew and to enhance the reliability of the overall scanning and recognition process, the bills are firmly gripped under uniform pressure between the driven and passive rolls. The H-shaped leaf springs 252 and 253 aid in reducing bill twisting or skewing. The O-rings 244, 245 are also effective in ensuring that central portions of the bills are held flat. The distance between the axes of the two driven upper rolls 223 and 241 and the corresponding counter-rotating passive rolls 250 and 251 is selected to be just short of a length of a narrow dimension of the currency bills.

FIG. 6 depicts various shafts of the multi-pocket document evaluation device according to one embodiment of the present invention. The distance between the shafts should preferably be less than the width of the bills that are to be evaluated.

As best shown in FIG. 7a, according to one embodiment of the present invention the transport plate 240 is substantially flat and linear. The uncomplicated surfaces of the transport plate 240 have no protruding features. In one embodiment, there are no belts employed to engage and advance bills after they have been evaluated in the evaluation region 247. In this

embodiment, the bills are delivered to an appropriate output receptacle 217a or 217b after being evaluated without the use of belts contacting the bills.

The transport plate 240 has a first substantially planar region 240a defining a first plane. The evaluation of bills is performed in the first substantially planar region 240a. The first substantially planar region 240a ends at a point 300. The transport plate 240 also has a second substantially planar region 240b defining a second plane. The second substantially planar region 240b begins at the point 300. The second substantially planar region extends up to a diverting flange 240d. In one embodiment, the first and second substantially planar regions 240a and 240b substantially define the entire region of the transport path from the evaluation mechanism to the plurality of output receptacles 217a,b.

In one embodiment, the second substantially planar region 240b does not deviate from the first substantially planar region 240a by more than about 90 degrees. In a second embodiment, the second region 240b does not deviate from the first region 240a by more than about 60 degrees. In a third embodiment, the second region 240b does not deviate from the first region 240a by more than about 45 degrees. In a fourth embodiment, the second region 240b does not deviate from the first region 240a by more than about 30 degrees. As depicted in FIG. 7a, the second region 240b is substantially planar with the first region 240a, deviating from the first region 240a by an angle of  $\alpha$  degrees where  $\alpha$  is about 26 degrees.

The transport plate 240 also has a third substantially planar region 240c defining a third plane. In one embodiment, the third substantially planar region 240c does not deviate by more than about 45 degrees from the first region 240a. In another embodiment, the third region 240c does not deviate by more than about 25 degrees from the first region 240a. As depicted in FIG. 7a, the third region 240c deviates from the first region 240a by an angle of  $\beta$  degrees where  $\beta$  is about 16 degrees.

The transport plate 240 has a plurality of apertures 25 therein. According to one embodiment, apertures 25 are present only where necessary to facilitate the functioning of passive rolls and driven rolls and a diverter 260. According to another embodiment, apertures 25 are present only where necessary to facilitate the functioning of passive and driven rolls, diverter 260, and various sensors such as scanheads, doubles detectors, and document location sensors. Apertures for sensors may be covered with materials that do not interfere with the functioning of corresponding sensors while nonetheless facilitating the transport plate in appearing smooth and continuous to passing bills. For example, when optical sensors are



being employed, corresponding apertures may contain lenses that are flush with the transport surface of the transport plate. Likewise, materials that do not interfere with the operation of magnetic sensors may be employed to cover any apertures created to facilitate their operation. Accordingly, such coverings essentially become part of the transport plate, effectively negating the existence of the corresponding apertures. Alternatively, the transport plate may be constructed from a material that does not interfere with the operation of such sensors so that no apertures need be created in the first place, *e.g.*, a clear plastic transport plate permitting the functioning of optical sensors.

Apertures 25 in first region 240a of the transport plate 240 are shown in FIG. 7b.

Apertures 25a permit passive and driven rolls to protrude into the currency pathway to thereby advance bills along the pathway. Apertures 25b permit ends of the diverter 260 to rotate below the upper surface of the transport plate 240. Aperture 25c permits a lower scanhead to read the underside of a passing document. The lower scanhead may be, for example, an optical scanhead. Apertures 25d provide access for double detection sensors that determine whether two or more bills are being transported in a stacked or overlapping manner. An example of optical scanheads and double detection sensor are described in more detail in conjunction with FIGs. 13-16. Apertures 25c and 25d may contain lenses that are flush with the transport surface of the transport plate. Where apertures 25c and 25d contain such lenses, the transport plate 240a effectively contains only apertures 25a and 25b (*i.e.*, apertures only for the transport rolls and the diverter).

Apertures 25a and 25b in a second region 240b of the transport plate 240 are shown in FIG. 7d. This clean and unobstructed of transport plate 240 facilitates a reduction in the jamming of the currency bills as well as facilitating the ease with which jammed bills can be removed from the system 10.

According to one embodiment, the transport plate 240 has a unitary and integral construction. Such an embodiment is depicted in FIGs. 2 and 7a-7e. However, the transport plate 240 may be constructed of a plurality of individual plates. Such an alternate embodiment is illustrated in FIGs. 10a-10b and 11a-11b. Referring to FIG. 11b, a portion of a transport plate 240' is depicted in which one of a plurality of individual plates is illustrated. The transport plate 240' includes the portion depicted in FIG. 11b and another portion 240'' (see FIG. 10a) in the vicinity of the evaluation region. In one embodiment, the transport plate 240'' is comprised of a molded plastic plate. Both portions of the transport plate 240' and 240'' in this embodiment are substantially flat and linear. As depicted, the surfaces of the

transport plate 240' have no protruding features. As described above in connection with plate 240, in this embodiment, the bills are delivered to an appropriate output receptacle 217a or 217b after being evaluated without the use of belts contacting the bills.

The portion of the transport plate 240' depicted in FIG. 11b has a first substantially planar region 240e defining a first plane. The substantially planar region 240e according to this embodiment begins after the bills have been evaluated. The substantially planar region 240e may optionally be slightly angled at a point 301' to assist in preventing bills from getting caught in the area between the evaluating mechanism and the substantially planar region 240e. As illustrated, the first substantially planar region 240e ends at a point 300'. The transport plate 240' also has a second substantially planar region 240f defining a second plane. The second substantially planar region 240f begins at the point 300'. The second substantially planar region extends up to a diverting flange 240g. In one embodiment, the first and second substantially planar regions 240e and 240f define substantially the entire path from the evaluation region to the plurality of output receptacles 217a,b.

In one embodiment, the second substantially planar region 240f does not deviate from the first substantially planar region 240e by more than about 90 degrees. In a second embodiment, the second region 240f does not deviate from the first region 240e by more than about 60 degrees. In a third embodiment, the second region 240f does not deviate from the first region 240e by more than about 45 degrees. In a fourth embodiment, the second region 240f does not deviate from the first region 240e by more than about 30 degrees. As depicted in FIG. 11b, the second region 240f is substantially planar with the first region 240e, deviating from the first region 240e by an angle of  $\gamma$  degrees where  $\gamma$  is about 26 degrees.

As with the transport plate 240, transport plate 240' has a plurality of apertures 27 therein. According to one embodiment, apertures 27 are present only where necessary to facilitate the functioning of passive rolls and driven rolls and a diverter 260. According to another embodiment, apertures 27 are present only where necessary to facilitate the functioning of passive and driven rolls, diverter 260, and various sensors such as scanheads, doubles detectors, and document location sensors. Apertures for sensors may be filled with materials that do not interfere with the functioning of corresponding sensors while nonetheless facilitating the transport plate in appearing smooth and continuous to passing bills. For example, when optical sensors are being employed, corresponding apertures may contain lenses that are flush with the transport surface of the transport plate.

Apertures 27 of the transport plate 240' are shown in FIG. 11a. Apertures 27a permit passive and driven rolls to protrude into the currency pathway. Apertures 27b permit ends of the diverter 260 to rotate below the upper surface of the transport plate 240'. Apertures 27c facilitate the functioning of sensors such as sensors 235a and 235b described below in connection with FIGs. 8a and 9a. This clean and unobstructed of transport plate 240' facilitates a reduction in the jamming of the currency bills as well as facilitating the ease with which jammed bills can be removed from the system 10.

FIGs. 8a-8c and 9a-9c illustrate, respectively, first and second follower plates 262 and 278. As illustrated, these plates are substantially free from surface features and are substantially smooth like the transport plate 240. The follower plates 262 and 278 are positioned in spaced relation to transport plate 240 so as to define a currency pathway there between. The follower plates 262 and 278 and the transport plate such a 240 or 240' contribute to defining a pathway that is free and unencumbered between the roll 251 and the output receptacles 217a and 217b for the bill. As illustrated, the follower plates 262 and 278 have apertures only where necessary for accommodation of passive rolls 268, 270, 284, and 286. The apertures 25c accommodating passive rolls 268 and 270 in the follower plate 262 are shown in FIG. 8c, while the apertures 25d accommodating passive rolls 284 and 286 are shown in FIG. 9c. Thus according to one embodiment a transport mechanism is employed that uses no belts to advance bills from the evaluation region to a plurality of output receptacles.

Referring specifically to FIG. 8a, the follower plate 262 in conjunction with the upper portion of the transport plate 240 guide a bill 20 from the passive roll 251 to a driven roll 264 and then to a driven roll 266. The passive rolls 268, 270 are biased by H-springs 272 and 273 into counter-rotating contact with the corresponding driven rolls 264 and 266 in a manner similar as described above in connection with passive rolls 250 and 251.

A diverter 260 is employed to direct the bill 20 to the appropriate output receptacle 217a or 217b. The bill 20 will encounter the diverter 260 after emerging from between the driven roll 266 and the passive roll 270. Diverter 260 includes a plurality of flanges mounted across the transport path on a shaft 274. Two solenoids 261a,b, one mounted on each end of the shaft 274 (see FIG. 6), cause the shaft and the attached diverter flanges to rotate into either a lower position or an upper position. The two solenoids drive the shaft 274 in opposite directions and an appropriate one of the two solenoids is energized depending upon whether the diverter 260 is to be moved from its lower position to its upper position or vice versa. The

use of a separate solenoid for each rotational direction enhances the performance of the diverter 260 by increasing of the speed with which the position of the diverter 260 may be changed.

When the diverter 260 is in the lower position, the ends of the flanges are positioned below the upper surface of the transport plate 240. Apertures 25b in transport plate 240 (see FIGs. 7b and 7d) facilitate this position while apertures 27b in transport plate 240' (see FIG. 11a) facilitate this position. The apertures 25b and 27b correspond in location and size to the diverter 260 which enables the diverter 260 to protrude through the transport plate 240 and create a smooth ramp for directing the bills into the upper output receptacle 217a.

When the diverter 260 is in the upper position (as shown in FIG. 8a), bills are directed between the transport plate 240 and the follower plate 278 (see FIG. 9a). The transport plate 240 and the follower plate 278 guide bills after the diverter 260 to a driven roll 280 and then to a driven roll 282.

Also illustrated in FIG. 8a is a sensor 235a. Sensor 235a may be used to detect when bills pass by the sensor. This sensor may be used to aid in determining when the position of diverter 260 may be changed and/or used to detect when bills have become jammed either upstream of this sensor or over this sensor. For example, if no bills pass this sensor for a predetermined period of time when bills are expected to be passing this sensor, a jam condition error may be generated to stop the transport mechanism and prompt the operator as to the existence and location of a jam. Sensor 235a may be, for example, an optical sensor that detects light reflected off the follower plate 262. A change in the amount of light being reflected back to the sensor 235a may then indicate that a bill is passing by this sensor.

FIG. 9a illustrates a bill 20 between the driven rolls 280 and 282 and their respective passive rolls 284 and 286. The passive rolls 284, 286 are biased by H-springs 288, 289 into passive counter-rotating contact with the driven rolls 280, 282, respectively, in a manner similar to that described above in connection with passive rolls 250, 251. Bills are then directed to the lower output receptacle 217b via the stacker wheels 212b and 213b. Also illustrated in FIG. 9a is a sensor 235b. Sensor 235b may be used to detect when bills pass by the sensor. The above description of sensor 235a in connection with FIG. 8a likewise applies to sensor 235b.

As shown in FIG. 10a in one embodiment of the invention, the follower plates 262 and 278 are part of an assembly 30 that also includes the output receptacles 217a,b including stacker wheels 212a,b, 213a,b (a moveable assembly 30 can also be seen in phantom in FIG.

2). As shown in FIG. 10a, this assembly 30 can be moved away from the remainder 40 of the document evaluation device 10 which may be, for example, a currency discriminator.

Assembly 30 is hingedly connected to the remainder of document evaluation device 40 about pivot 35. This arrangement allows the assembly 30 to rotate outward and away from the remainder of currency discriminator 40 and to expose the transport plate 240', thereby  
 5 permitting access to the transport plate 240' after the evaluation region 247. In one embodiment, assembly 30 is maintained in its open position by its own weight. Alternatively, springs 320 (see FIG. 2) may be used in conjunction with the pivot 35 to maintain this assembly in its open position. The resulting unobstructed access allows users of the  
 10 discriminator to easily clear jams without a complicated procedure or the need to put a hand into a restricted, difficult to access, and sometimes dirty region. Likewise, the smooth transport and follower plates contribute to the easy removal of bills.

Assembly 30 in one embodiment of the present invention also includes a pivoting mechanism or lever 33a adjacent to follower plate 262. When in its closed position, the lever  
 15 33a is biased upward by a spring (not shown) with a hub 33b fitting into a notch 42 which maintains the assembly 30 in its closed position and the follower plate 262 in spaced relation to transport plate 240e. To move assembly 30 into its open position, the lever 33a is moved downward so that hub 33b is not engaging notch 42. The assembly 30 may then be rotated away from the remainder of the document evaluation device. The lever 33a also assists in  
 20 moving the assembly 30 away from the remainder of currency discriminator 40.

FIG. 10b is a side view depicting an evaluation device in an open position according to another embodiment of the present invention that is similar to that shown in FIG. 10a.

FIGs. 12a-c depict multi-pocket document evaluation devices 10, such as a currency discriminators, according to other embodiments of the present invention. FIG. 12a depicts a  
 25 three-pocket document evaluation device 10, such as a currency discriminator. FIG. 12b depicts a four-pocket document evaluation device 10, such as a currency discriminator. FIG. 12c depicts a six-pocket document evaluation device 10, such as a currency discriminator.

The multi-pocket document evaluation devices 10 in FIGs. 12a-c have a transport mechanism which includes a transport plate or guide plate 240 for guiding currency bills to  
 30 one of a plurality of output receptacles 217. The transport plate 240 according to one embodiment is substantially flat and linear without any protruding features. Before reaching the output receptacles 217, a bill can be, for example, evaluated, analyzed, authenticated, discriminated, counted and/or otherwise processed.

The multi-pocket document evaluation devices 10 move the currency bills in seriatim from the bottom of a stack of bills along the curved guideway 211 which receives bills moving downwardly and rearwardly and changes the direction of travel to a forward direction. An exit end of the curved guideway 211 directs the bills onto the transport plate 240 which carries the bills through an evaluation section and to one of the output receptacles 217. A plurality of diverters 260 direct the bills to the output receptacles 217. When a diverter 260 is in its lower position, bills are directed to the corresponding output receptacle 217. When a diverter 260 is in its upper position, bills proceed in the direction of the remaining output receptacles.

The multi-pocket document evaluation devices 10 of FIGs. 12a-c according to one embodiment includes passive rolls 250, 251 which are mounted on an underside of the transport plate 240 and are biased into counter-rotating contact with their corresponding driven upper rolls 223 and 241. Other embodiments includes a plurality of follower plates which are substantially free from surface features and are substantially smooth like the transport plate 240. The follower plates 262 and 278 are positioned in spaced relation to transport plate 240 so as to define a currency pathway there between. In one embodiment, follower plates 262 and 278 have apertures only where necessary for accommodation of passive rolls 268, 270, 284, and 286.

The follower plate 262 works in conjunction with the upper portion of the transport plate 240 to guide a bill 20 from the passive roll 251 to a driven roll 264 and then to a driven roll 266. The passive rolls 268, 270 are biased by H-springs into counter-rotating contact with the corresponding driven rolls 264 and 266.

FIG. 13 is an enlarged vertical section taken approximately through the center of another embodiment of a machine having two output receptacles, 2217a and 2217b, showing various transport rolls in side elevation. A diverter 2260 is provided to direct bills into either receptacle 2217a or 2217b depending upon the results of the denomination discriminating unit and any authenticating means that may be present.

From the input receptacle 2210, the currency bills are moved in seriatim from the bottom of the stack along a curved guideway 2211 which receives bills moving downwardly and rearwardly and changes the direction of travel to a forward direction. The curvature of the guideway 2211 corresponds substantially to the curved periphery of the drive roll 2223 so as to form a narrow passageway for the bills along the rear side of the drive roll. The exit end of the guideway 2211 directs the bills onto a linear path where the bills are scanned. The bills

are transported and stacked with the narrow dimension of the bills maintained parallel to the transport path and the direction of movement at all times.

Stacking of the bills is effected in each output receptacle by a pair of driven stacking wheels 2212a and 2213a in output receptacle 2217a and stacking wheels 2212b and 2213b in  
 5 output receptacle 2217b. These wheels project upwardly through a pair of openings in respective stacker plates 2214a,b. The stacker wheels 2212a,b and 2213a,b are supported for rotational movement about respective shafts 2215a,b journaled on a rigid frame and driven by a motor. The flexible blades of the stacker wheels deliver the bills into a respective one of the output receptacles 2217a,b at the forward end of the respective stacker plates 2214a,b.

10 During operation, a currency bill which is delivered to a respective stacker plate 2214a,b is picked up by the flexible blades and becomes lodged between a pair of adjacent blades which, in combination, define a curved enclosure which decelerates a bill entering therein and serves as a means for supporting and transferring the bill into a respective output receptacle 2217a,b as the stacker wheels 2212a,b and 2213a,b rotate. The mechanical configuration of the  
 15 stacker wheels, as well as the manner in which they cooperate with the stacker plate, is conventional and, accordingly, is not described in detail herein.

The input region of the machine as shown in FIG. 13 the same as that described in connection with FIG. 3 and according will not be described again here.

The stripping wheels mounted on shaft 2221 feed each bill onto a drive roll 2223  
 20 mounted on a driven shaft 2224 supported across the side walls. The drive roll 2223 is the same as drive roll 223 (FIG. 2) described above. Likewise the operation of the stripping wheel and drive roll 2223 is the same as described above in connection with stripping wheels 220 and drive roll 223 (FIG. 3). Likewise, in order to ensure firm engagement between the drive roll 2223 and the currency bill being fed, an idler roll 2230, stripper wheels 2233,2234,  
 25 and pressure roll 2236 operate as described above in connection with FIG. 3. and in United States patent application Serial No. 08/450,505 filed May 26, 1995, entitled "Method and Apparatus for Discriminating and Counting Documents" which is incorporated by reference in its entirety.

At the lower end of the curved guideway 2211, the bill being transported by the drive  
 30 roll 2223 engages a flat guide plate 2240. Currency bills are positively driven along the flat plate 2240 by means of a transport roll arrangement which includes the drive roll 2223 at one end of the plate and a smaller driven roll 2241 at the other end of the plate. Both the driver roll 2223 and the smaller roll 2241 include pairs of smooth raised cylindrical surfaces which

hold the bill flat against the plate 2240. A pair of O rings 2244 and 2245 fit into grooves formed in both the roll 2241 and the roll 2223 to engage the bill continuously between the two rolls 2223 and 2241 to transport the bill while helping to hold the bill flat against the guide plate 2240.

5           The flat guide plate 2240 is provided with openings through which the raised surfaces of both the drive roll 2223 and the smaller driven roll 2241 are subjected to counter-rotating contact with corresponding pairs of passive transport rolls 2250 and 2251 having high-friction rubber surfaces. The passive rolls 2250, 2251 are mounted on the underside of the flat plate 2240 in such a manner as to be freewheeling about their axes 2254 and 2255 and biased into  
10 counter-rotating contact with the corresponding upper rolls 2223 and 2241. The passive rolls 2250 and 2251 are biased into contact with the driven rolls 2223 and 2241 by means of a pair of H-shaped leaf springs 2252 and 2253. Each of the four rolls 2250, 2251 is cradled between a pair of parallel arms of one of the H-shaped leaf springs 2252 and 2253.

          The points of contact between the driven and passive transport rolls are preferably  
15 coplanar with the flat upper surface of the plate 2240 so that currency bills can be positively driven along the top surface of the plate in a flat manner. The distance between the axes of the two driven transport rolls, and the corresponding counter-rotating passive rolls, is selected to be just short of the length of the narrow dimension of the currency bills. Accordingly, the bills are firmly gripped under uniform pressure between the upper and lower transport rolls within  
20 the area of scanhead 2247, thereby minimizing the possibility of bill skew and enhancing the reliability of the overall scanning and recognition process. The positive guiding arrangement described above is advantageous in that uniform guiding pressure is maintained on the bills as they are transported through the scanhead area, and twisting or skewing of the bills is substantially reduced. This positive action is supplemented by the use of the H-springs 2252,  
25 2253 for uniformly biasing the passive rollers into contact with the active rollers so that bill twisting or skew resulting from differential pressure applied to the bills along the transport path is avoided. The O-rings 2244, 2245 function as simple, yet extremely effective means for ensuring that the central portions of the bills are held flat.

          Guide plate 2240 extends from the region of curved guideway 2211 to a region in the  
30 vicinity the diverter 2260. A guide plate 2262 in conjunction with the lower portion of the guide plate 2240 guide bills from between rolls 2241 and 2251 to driven roll 2264 and then to driven roll 2266. Passive rolls 2268, 2670 are biased by H-springs 2272, 2273 into counter-rotating contact with rolls 2264 and 2266, respectively, in a manner similar to that described



above in connection with rolls 2250, 2251. Bills emerge from between rolls 2266 and 2270 and are directed into diverter 2260. Diverter 2260 comprises a plurality of flanges mounted across the transport path on shaft 2274. Two solenoids, one mounted on each end of shaft 2274, cause the shaft and the attached diverter flanges to rotate into either a lower position or an upper position. The two solenoids drive the shaft 2274 in opposite directions and an appropriate one of the two solenoids is energized depending upon whether the diverter 2260 is to be moved from its lower position to its upper position or vice versa. The use of a separate solenoid for each rotational direction enhances the performance of the diverter by increasing the speed with which the position of the diverter may be changed.

When the diverter is in its lower position, bills are directed to the upper output receptacle 2217a via stacker wheels 2212a and 2213a. When the diverter is in its upper position, bills are directed between guide plates 2276 and 2278. Guide plates 2276 and 2278 guide bills from the diverter 2260 to driven roll 2280 and then to driven roll 2282. Passive rolls 2284, 2286 are biased by H-springs 2288, 2289 into counter-rotating contact with rolls 2280 and 2282, respectively, in a manner similar to that described above in connection with rolls 2250, 2251. Bills are then directed to the lower output receptacle 2217b via stacker wheels 2212b and 2213b.

### **Evaluation Region**

The characteristics of the evaluation region 247, 2247 may vary according to the particular application and needs of the user. The evaluation region can accommodate a number and variety of different types of sensors depending on a number of variables. These variables are related to whether the machine is authenticating, counting or discriminating and what distinguishing characteristics are being examined, *e.g.*, size, color, magnetism, reflectivity, absorbability, transmissivity, electrical conductivity, etc.

The evaluation region 247, 2247 may employ a variety of detection means such as magnetic or optical sensors. For example, a variety of currency characteristics can be measured using magnetic sensing. These include detection of patterns of changes in magnetic flux (U.S. Pat. No. 3,280,974), patterns of vertical grid lines in the portrait area of bills (U.S. Pat. No. 3,870,629), the presence of a security thread (U.S. Pat. No. 5,151,607), total amount of magnetizable material of a bill (U.S. Pat. No. 4,617,458), patterns from sensing the strength of magnetic fields along a bill (U.S. Pat. No. 4,593,184), and other patterns and counts from scanning different portions of the bill such as the area in which the denomination is written out

(U.S. Pat. No. 4,356,473). Additionally, a magnetoresistive sensor or a plurality of such sensors including an array of magnetoresistive sensors may be employed to detect, for example, magnetic flux. Examples of magnetoresistive sensors are described in, for example, U.S. Pat. Nos. 5,119,025, 4,683,508, 4,413,296, 4,388,662, and 4,164,770. Another example  
5 of a magnetoresistive sensor that may be used is the Gradiometer available from NVE Nonvolatile Electronics, Inc., Eden Prairie, MN. Additionally, other types of magnetic sensors may be employed for detecting magnetic flux such as Hall effect sensors and flux gates.

With regard to optical sensing, a variety of currency characteristics can be measured such as detection of density (U.S. Pat. No. 4,381,447), color (U.S. Pat. Nos. 4,490,846;  
10 3,496,370; 3,480,785), length and thickness (U.S. Pat. No. 4,255,651), the presence of a security thread (U.S. Pat. No. 5,151,607) and holes (U.S. Pat. No. 4,381,447), and other patterns of reflectance and transmission (U.S. Pat. No. 3,496,370; 3,679,314; 3,870,629; 4,179,685). Color detection techniques may employ color filters, colored lamps, and/or dichroic beamsplitters (U.S. Pat. Nos. 4,841,358; 4,658,289; 4,716,456; 4,825,246, 4,992,860  
15 and EP 325,364). The use of ultraviolet light is also a useful discrimination and authentication tool. An optical sensing system using ultraviolet light is described in the assignee's co-pending U.S. patent application Serial No. 08/317,349, filed October 4, 1994, and incorporated herein by reference in its entirety.

In addition to magnetic and optical sensing, other techniques of detecting characteristic  
20 information of currency include electrical conductivity sensing, capacitive sensing (U.S. Pat. No. 5,122,754 [watermark, security thread]; 3,764,899 [thickness]; 3,815,021 [dielectric properties]; 5,151,607 [security thread]), and mechanical sensing (U.S. Pat. No. 4,381,447 [limpness]; 4,255,651 [thickness]). Alternatively or additionally, sensors may be employed to detect bills or security threads printed or coated with thermochromatic materials (materials  
25 that change color with a change in temperature). Examples of threads incorporating thermochromatic materials are described in U.S. Pat. No. 5,465,301 incorporated herein by reference.

Although not illustrated in the drawings, it should be noted that corresponding photodetectors (not shown) may be provided within the evaluation area in immediate  
30 opposition to corresponding light sources. These detectors detect the beam of coherent light directed downwardly onto the bill transport path from corresponding the light sources and generate an analog output which corresponds to the sensed light. Two-sided scanning may be used to permit bills to be fed into a currency discrimination system according to the present

invention with either side face up. An example of a two-sided scanhead arrangement is disclosed in U.S. Pat. No. 5,467,406, incorporated herein by reference in its entirety. Another example of a two-sided scanhead arrangement is described in co-pending United States patent application Serial No. 08/450,505 referred to above and incorporated by reference in its entirety. Further, to accommodate scanning in areas other than the central portion of a bill, multiple scanheads may be laterally positioned next to each other. Examples of multiple scanhead arrangements are described in co-pending U.S. patent application Serial No. 08/287,882 incorporated herein by reference in its entirety.

Some examples of scanheads are depicted in FIGs. 13-16. These scanheads may be, for example, incorporated into the evaluation devices depicted in FIGs. 1, 3, 10a-10b and 12a-12c. As illustrated in FIGs. 13-16, the housing for each scanhead is formed as an integral part of a unitary molded plastic support member 280 or 281. The lower member 281 also forms the transport plate 240 that receives the bills from the drive roll 223 and supports the bills as they are driven past the scanheads 18a and 18b.

The two support members 280 and 281 are mounted facing each other so that the lenses 282 and 283 of the two scanheads 18a, 18b define a narrow gap through which each bill is transported. The upper support member 280 includes a tapered entry guide 280a which guides an incoming bill into the gaps between the various pairs of opposed lenses.

The lower support member 281 is attached rigidly to the machine frame. The upper support member 280, however, is mounted for limited vertical movement when it is lifted manually by a handle 284, to facilitate the clearing of any paper jams that occur beneath the member 280. To allow for such vertical movement, the member 280 is slidably mounted on a pair of posts 285 and 286 on the machine frame, with a pair of springs 287 and 288 biasing the member 280 to its lowermost position.

Each of the two optical scanheads 18a and 18b housed in the support members 280, 281 includes a pair of light sources acting in combination to uniformly illuminate light strips of the desired dimension on opposite sides of a bill as it is transported across the plate 240. Thus, the upper scanhead 18a includes a pair of LEDs 22a, directing light downwardly through an optical mask on top of the lens 282 onto a bill traversing the flat guide plate 240 beneath the scanhead. The LEDs 22a are angularly disposed relative to the vertical axis of the scanhead so that their respective light beams combine to illuminate the desired light strip defined by an aperture in the mask. The scanhead 18a also includes a photodetector 26a mounted directly over the center of the illuminated strip for sensing the light reflected off the

strip. A lower scanhead 18b includes a pair of LEDs 22b, directing light upwardly through an optical mask on top of the lens 283 onto a bill traversing the flat guide plate 240 above the scanhead.

Turning now to FIG. 17, there is shown a functional block diagram illustrating an embodiment of a document authenticator and discriminator according to the present invention. The discriminator system 402 comprises an input receptacle 404 for receiving a stack of currency bills. A transport mechanism defining a transport path (as represented by arrow M) transports the bills in the input receptacle, one at a time, past one or more sensors of an authenticating and discriminating unit 406. Bills are then transported to one of a plurality of output receptacles 408 (arrow N). The system 402 may correspond, for example, to the discriminators described above having multiple output pockets such as those shown in FIGs. 1-2, 10a-10b, and 12a-12c. The authenticating and discriminating unit scans and determines the denomination of each passing bill. Any variety of discriminating techniques may be used. For example, the discriminating method disclosed in U.S. Pat. No. 5,295,196 (incorporated by reference herein in its entirety) may be employed to optically scan each bill. Depending on the characteristics of the discriminating unit employed, the discriminator may be able to recognize bills only if fed face up or face down, regardless of whether fed face up or face down, only if fed in a forward orientation or reverse orientation, regardless of whether fed in a forward or reverse orientation, or some combination thereof. Additionally, the discriminating unit may be able to scan only one side or both sides of a bill. In addition to determining the denomination of each scanned bill, the authenticating and discriminating unit 406 may additionally include various authenticating tests such as an ultraviolet authentication test as disclosed in U.S. patent application Serial No. 08/317,349 filed on October 4, 1994 for a "Method and Apparatus for Authenticating Documents Including Currency" incorporated herein by reference in its entirety. Likewise, the authenticating and discriminating unit 406 may additionally include other authentication tests such as thread detection, enhanced magnetics tests, and color authentication tests including those described in co-pending U.S. patent application Serial No. 08/800,053, filed on February 14, 1997 entitled "Method and Apparatus for Document Identification and Authentication" incorporated herein by reference in its entirety.

Signals from the authenticating and discriminating unit 406 are sent to a signal processor such as a central processor unit ("CPU"). The CPU records the results of the authenticating and discriminating tests in a memory. When the authenticating and

discriminating unit 406 is able to confirm the genuineness and denomination of a bill, the value of the bill is added to a total value counter in memory that keeps track of the total value of the stack of bills that were inserted in the input receptacle 404 and scanned by the authenticating and discriminating unit 406. Additionally, depending on the mode of operation of the discriminator system 402, counters associated with one or more denominations may be maintained in the memory. For example, a \$1 counter may be maintained to record how many \$1 bills were scanned by the authenticating and discriminating unit 406. Likewise, a \$5 counter may be maintained to record how many \$5 bills were scanned, and so on. In an operating mode where individual denomination counters are maintained, the total value of the scanned bills may be determined without maintaining a separate total value counter. The total value of the scanned bills and/or the number of each individual denomination may be displayed on a display such as a monitor or LCD display.

A discriminating unit such as the authenticating and discriminating unit 406 may not be able to identify the denomination of one or more bills in the stack of bills loaded into the input receptacle 404. For example, if a bill is excessively worn or soiled or if the bill is torn a discriminating unit may not be able to identify the bill. Furthermore, some known discrimination methods do not have a high discrimination efficiency and thus are unable to identify bills which vary even somewhat from an "ideal" bill condition or which are even somewhat displaced by the transport mechanism relative to the scanning mechanism used to discriminate bills. Accordingly, such poorer performing discriminating units may yield a relatively large number of bills which are not identified. Alternatively, some discriminating units may be capable of identifying bills only when they are fed in a predetermined manner. For example, some discriminators may require a bill to be faced in a predetermined manner. Accordingly, when a bill is fed face down past a discriminating unit which can only identify bills fed face up, the discriminating unit can not identify the bill. Likewise, other discriminators require a specific edge of a bill to be fed first, for example, the top edge of a bill. Accordingly, bills which are not fed in the forward direction, that is, those that are fed in the reverse direction, are not identified by such a discriminating unit.

According to one embodiment, the discriminator system 402 is designed so that when the authenticating and discriminating unit is unable to identify a bill, the unidentified note is "presented" in one of the output receptacles, that is, the transport mechanism is stopped so that the unidentified bill is located at a predetermined position within one of the output receptacles, such as being the last bill transported to one of the output receptacles. For

example, where the unidentified bill is the last bill transported to an output receptacle, it may be positioned within the stacker wheels or positioned at the top of or at the rear of the stack of bills resting on a stacker plate in the output receptacle 408. The output receptacles 408 are preferably positioned within the discriminator system 402 so that the operator may

5 conveniently see the flagged bill and/or remove it for closer inspection. Accordingly, the operator is able to easily see the bill which has not been identified by the authenticating and discriminating unit 406. The operator may then either visually inspect the flagged bill while it is resting on the top of or at the rear of the stack, or alternatively, the operator may chose to remove the bill from the output receptacle in order to examine the flagged bill more closely.

10 According to another embodiment, when a bill is flagged, the transport mechanism may be stopped before the flagged bill is transported to one of the output receptacles. Such an embodiment is particularly suited for situations in which the operator need not examine the bill being flagged, such as upon the occurrence of a denomination change or separate series error described below. For example, upon the occurrence of a denomination change where all

15 available output receptacles already have one or more bills in them, the machine may stop with the denomination change bill residing within the transport mechanism. The machine may then prompt the operator to remove all the bills from a given output receptacle. When the operator does so, the machine automatically resumes operation (or alternatively, the machine may resume operation after the selection of a continue key) and delivers the denomination change

20 bill into the cleared output receptacles.

The discriminator system 402 may be designed to continue operation automatically when a flagged bill is removed from the output receptacle or, according to one embodiment of the present invention, may be designed to require a selection element to be depressed. Upon examination of a flagged bill by the operator, it may be found that the flagged bill is genuine

25 even though it was not identified by the discriminating unit. However, because the bill was not identified, the total value and/or denomination counters in the memory will not reflect its value. According to one embodiment, such an unidentified bill is removed from the output stack and either re-fed through the discriminator or set aside. In the latter case, any genuine set aside bills are counted by hand.

30 In order to avoid problems associated with re-feeding bills, counting bills by hand, and adding together separate totals, according to one embodiment of the present invention, a number of selection elements associated with individual denominations are provided. These selection elements may be in the form of keys or buttons of a keypad. Other types of selection

elements such as switches or displayed keys in a touch-screen environment may be employed. When an operator determines that a flagged bill is acceptable, the operator may simply depress the selection element associated with the denomination of the flagged bill and the corresponding denomination counter and/or the total value counter are appropriately

5 incremented and the discriminator system 402 resumes operating again. In non-automatic restart discriminators, where an operator has removed a genuine flagged bill from the output receptacle for closer examination, the bill is first replaced into the output receptacle before a corresponding selection element is chosen.

An advantage of the above described procedure is that appropriate counters are

10 incremented and the discriminator is restarted with the touch of a single key, greatly simplifying the operation of the discriminator system 402 while reducing the opportunities for human error. When an operator determines that a flagged bill is not acceptable, the operator may remove the unacceptable flagged bill from the output receptacle without replacement and depress a continuation key on the keypad. When the continuation key is selected, the

15 denomination counters and the total value counter are not affected and the discriminator system 402 will resume operating again. In automatic restart discriminators, the removal of a bill from the output receptacle is treated as an indication that the bill is unacceptable and the discriminator automatically resumes operation without affecting the denomination counters and/or total value counters.

20 With respect to FIG. 17, in one embodiment, where the authenticating and discriminating unit determines that a bill is a fake, the flagged bill is routed to a separate one of said output receptacles. The operation of the discriminator may or may not then be suspended. When a bill is not determined to be fake but for some reason the authenticating and discriminating unit 406 is not able to identify the denomination of the bill, the no call bill

25 may be transported one of the output receptacles. In one embodiment, no call bills are transported to a separate one of the output receptacles. In another embodiment, no calls are not delivered to a special separate output receptacle. The operation of the discriminator may or may not then be suspended.

In another embodiment according to FIG. 17, no call bills are delivered to an output

30 receptacle separate from the one or more output receptacles receiving identified bills. The operation of the discriminator need not be suspended until all the bills placed in the input receptacle have been processed. The value of any no call bills may then be added to the

appropriate counters after the stack of bills has been processed through a reconciliation process.

One embodiment that may be used for stopping the transport mechanism in response to the detection of an unidentified bill or a bill meeting some other criteria such as being a suspect bill, denomination change, etc., is described in more detail in U.S. Pat. No. 5,295,196 incorporated herein by reference in its entirety. Basically, one or more sensors retrieve information from passing bills. This information is processed by a signal processor such as a CPU. The position of bills in the transport mechanism is monitored. This monitoring of bill positioned is accomplished via the use of an optical encoder as described in U.S. Pat. No. 5,295,196. If the denomination of the bill is identified, the signal processor generates a signal indicative of the determined denomination. If the denomination of the bill is not determined, the signal processor generates a no call signal. If the signal processor determines the bill to be suspect, a suspect signal is generated or a particular type of suspect signal is generated indicative of the reason why the bill is believed to be suspect, e.g., failure of a magnetic test, failure of a UV test, etc. Additionally, error signals may be generated for other reasons including the detection of various minor errors such as a denomination change or stranger condition or the detection a major error such as doubles or chains. As a result of the generation of one or more of these error signals, the signal processor can be programmed to generate one or more signals that cause the transport mechanism to halt in a particular manner such as by sending appropriate signals to the motor driving the transport mechanism and/or to cause one or more diverters to direct bills toward an appropriate output receptacle such as by sending appropriate signals to the diverter driving mechanisms such as the solenoids described above. Positional information obtained from the encoder may be employed to stop a bill in a controlled manner and so that the bill is stopped in a predetermined position or identifiable location.

Turning now to FIG. 18, there is shown a functional block diagram illustrating a two-pocket document authenticator and discriminator according to one embodiment of the present invention. The discriminator system 403 comprises an input receptacle 404' for receiving a stack of currency bills. A transport mechanism defining a transport path (as represented by arrow M') transports the bills in the input receptacle, one at a time, past one or more sensors of an authenticating and discriminating unit 406'. Bills are then transported to one of two output receptacles 408', 408'' (as represented by arrows N', N'').



In one embodiment, where the authenticating and discriminating unit 406 determines that a bill is a fake, the flagged bill is routed to a specific one of the output receptacles. The operation of the discriminator may or may not then be suspended. When a bill is not determined to be fake but for some reason the authenticating and discriminating unit 406 is not able to identify the denomination of the bill, the no call bill may be transported to one of the output receptacles 408', 408".

In one embodiment, no call bills are transported to a specific one of the output receptacles 408', 408". In another embodiment, no call bills are not delivered to a special separate output receptacle. The operation of the discriminator may or may not then be suspended. For example, in a two output pocket discriminator, all bills may be transported to the same output receptacle regardless of whether they are determined to be suspect, no call, or properly identified. In this example, the operation of the discriminator may be suspended and an appropriate message displayed when a suspect or no call bill is encountered. Alternatively, suspect bills may be delivered to a specific one of the two output receptacles (*i.e.*, a reject receptacle) and no calls and identified bills may be sent to the other output receptacle. In this example, the operation of the discriminator need not be suspended when a suspect bill is encountered but may be suspended when a no call bill is encountered. If the operation is suspended at the time the no call bill is detected and the operator determines that the no call bill is acceptable, the operator returns the bill to the output receptacle from which it was removed (if it was removed) and selects a selection element (not shown) corresponding to the denomination of the flagged bill. Appropriate counters (not shown) are incremented, the discriminator system 403 resumes operation. On the other hand, if the operator determines that the flagged bill is unacceptable, the operator removes the bill without replacement from the output receptacle and selects a continuation element (not shown). The discriminator system 403 resumes operation without incrementing the counters associated with the various denomination and/or the total value counters.

In another embodiment, no call bills are delivered to a specific output receptacle separate from the output receptacle receiving identified bills. The operation of the discriminator need not be suspended until all the bills placed in the input receptacle 404 have been processed. Alternatively, the operation of the discriminator need not be suspended when a no call is encountered but may be suspended when a suspect bill is detected so that the operator may remove any suspect bills from the discriminator. The value of any no call bills may then be added to the appropriate counters after the stack of bills has been processed

through a reconciliation process. In an alternate embodiment, suspect and no call bills may be delivered to a specific one of the two output receptacles (*i.e.*, a reject receptacle) and identified bills may be sent to the other output receptacle. Additionally, according to this embodiment, the operation of the discriminator may be suspended and an appropriate message  
5 displayed when a suspect or no call bill is encountered.

As described above in connection with FIG. 17, when the transport mechanism is to be stopped in response to a bill being flagged, the flagged bill may be located at a predetermined position within an output receptacle, *e.g.*, last bill, in stacker wheel, or alternatively, the transport mechanism may be stopped before the flagged bill is transported to one of the output  
10 receptacles.

The system 403 may correspond, for example, to the discriminators described above having two output pockets such as those shown in FIGs. 1-2, and 10a-10b. In one embodiment, the discrimination system is selectively programmable among several operating modes so that an operator may select, for example, which bills to flag, in which pocket to  
15 direct the flagged or unflagged bills, and/or which stopping conditions to activate or deactivate. The several operating modes will be discussed in detail below. In any of the selected operating modes, the system may be programmed to deliver a flagged bill into a selected pocket and suspend operation of the machine to allow for inspection of the bill, as described in relation to FIG. 17, or the machine may be programmed to "off-sort" flagged or unflagged  
20 bills into a different pocket and either stop to allow for inspection of the "off-sorted" bill or continue processing the stack of bills without stopping.

A bill may be flagged and the discriminator systems described above such as those in conjunction with FIGs. 1-2, 10a-10b, 12a-12c, and 17-18 may be stopped upon encountering an unidentified or "no call" bill, as discussed above, or for any number of other stopping  
25 conditions. In general, these discriminator systems may stop upon the occurrence of minor errors or major errors, both of which will be discussed in detail below. These discriminator systems may include an audio alarm to provide an audible signal upon the occurrence of one or more of the minor or major error conditions. Preferably, the audio alarm is programmable to permit the operator to selectively activate or de-activate the audio alarm for any or all of the  
30 minor or major error conditions. The following description including the description relating to error conditions, operating modes, and touch panel screens are applicable to these discriminator systems and particularly to the above described discriminator systems having two output pockets such as shown in FIGs. 1-2, 10a-10b, 13, and 18. Furthermore, such

systems transport and divert bills to one of the output pockets at speeds equal to or greater than 600 documents per minute. According to another embodiment, such systems transport and divert bills to one of the output pockets at speeds equal to or greater than 800 documents per minute. According to another embodiment, such systems transport and divert bills to one of the output pockets at speeds equal to or greater than 1000 documents per minute. These systems may also employ flash card memories as described in co-pending U.S. application Serial No. 08/715,029, filed on September 17, 1996, entitled "Software Loading System for a Currency Scanner" incorporated herein by reference in its entirety.

### **Minor Error Conditions**

Minor errors are conditions which may or may not cause the machine to stop depending on the set-up, mode of operation, and error involved. Minors errors do not involve the review of more than one, if any, note. Minor errors do not disrupt running totals such as batch or sub-totals. According to one embodiment, the minor error conditions may be selectively activated or de-activated as desired by the user. For example, the machine may be programmed stop upon the occurrence of a "no call" document but not upon the occurrence of a "suspect document". The minor error conditions are listed as follows:

- |                             |                          |
|-----------------------------|--------------------------|
| 1) No Call (NC)             | 7) Unfit Document (UD)   |
| 2) Suspect Document (SD)    | 8) Reverse-Faced (RF)    |
| 3) Denomination Change (DC) | 9) Reverse-Oriented (RO) |
| 4) Stranger (S)             | 10) Strap Limit (SL)     |
| 5) Separate Series (SS)     | 11) Stacker Full (SF)    |
| 6) Improper Size (SZ)       |                          |

**No Call**

A “no call” condition occurs when the discriminating device is unable to identify or determine the denomination of a note, the unidentified note being termed a no call.

**Suspect Document**

A “Suspect Document” is a note that fails one or more authentication tests based on a variety of monitored parameters. A discriminating device may permit the operator to enable or disable the detection of Suspect Documents, by for example, enabling or disabling one or more the authentication tests.

**Denomination Change**

A “Denomination Change” condition occurs when a note is identified having a denomination other than prior bills or a target denomination while the machine is operating in one of the sort modes described below. For example, when a \$100 bill is scanned in a stack of previously scanned \$50 bills, the condition “Denomination Change” may occur under certain circumstances while the machine is operating in a sort mode.

**Stranger**

The “Stranger” condition occurs when a note is identified having a denomination other than prior bills or a target denomination while the machine is operating in one of the stranger modes described below. The stranger mode is generally used when it is expected that most bills in a stack are of the same denomination. The stranger condition will be discussed in greater detail hereinafter in connection with several stranger modes of operation.

**Separate Series (SS)**

A “Separate Series” condition occurs when a note is identified as having a different series than prior bills or a target series. For example, when a new-series \$100 bill (*i.e.*, a 1996-series \$100 bill) is scanned in a stack of previously scanned old-series \$100 bills, the condition “Separate Series” may occur. This function may be employed in conjunction with the modes described below where it is desired to discriminate of notes based on their series, *e.g.*, to discriminate between a 1993-series \$50 bills and 1950-series \$50 bills or to discriminate between all pre-1996 series U.S. notes from all 1996 and later series U.S. notes.

**Improper Size**

An “Improper Size” condition occurs when a document has a size that does not correspond to the size of one of the genuine documents that the system is programmed to recognize. For example, if the machine is set to process U.S. bills, then all documents should have the same size and any document that is not the same size as genuine U.S. currency will cause an “improper size” condition to occur. Likewise, for foreign bills, any document having a size other than one of the sizes of genuine foreign currency will cause an “improper size” condition to occur.

**Unfit Document**

An “Unfit Document” condition occurs when a document fails one or more fitness tests. Such fitness tests may detect, for example, the degree to which a bill is soiled, torn, or otherwise damaged. Likewise, the limpness of a document may also be employed as a fitness test.

**Reverse-Faced**

An “Reverse-Faced” condition occurs when a machine is operating in a facing mode and a document having a face orientation other than a target face orientation is detected.

**Reverse-Oriented**

An “Reverse-Oriented” condition occurs when a machine is operating in a Forward/Reverse Orientation mode and a document having a forward/reverse orientation other than a target forward/reverse orientation is detected.

### **Strap Limit**

The discrimination device may permit the setting of limits on the number of bills based on various conditions. For example, it may be desirable to gather \$20 bills into stacks of fifty bills. Accordingly, if for example bills are being processed such that \$20 bills and only \$20 are being directed into the first output receptacle, the device may halt after fifty \$20 bills have been delivered into the first pocket. The display may then indicate that a strap limit has been reached for the first output pocket. Various strap limits may be factory-preset or user-set. Alternatively, "Strap Limits" may be determined by combining the number of notes delivered to two or more of the output pockets.

### **Stacker Full**

The "Stacker Full" condition occurs when either or both of the pockets are at or near capacity and are not to receive additional notes. For example, in an embodiment in which the pockets are designed to receive a maximum of 300 currency notes, the discriminating device may be programmed to halt after 300 notes have been delivered to either of the pockets. The "stacker full" condition thereby will occur upon delivery of the 300th note. Similarly, in an embodiment in which the pockets are designed to receive 600 currency notes, the "stacker full" condition will occur upon delivery of the 600th note.

### **Major Error Conditions**

Major errors are conditions which typically will stop the machine and may require the operator to remove and re-process more than one note. According to one embodiment, major error conditions include Jam (J), Double (D) and Chain (C). The condition "Jam" occurs when one or more sensors detect that a jam is occurring when notes are being transported between the input receptacle and the output receptacles. The condition "Double" occurs when two or more notes are fed by the transport mechanism in a stacked manner. The condition "Chain" occurs when two or more notes are fed by the transport mechanism in an overlapping manner.

## **OPERATING MODES**

The discrimination system may be selectively programmed to operate in any of several operating modes. In general, these operating modes may be categorized as “stranger modes”, “sort modes”, “mixed modes” and “count modes”. As will be described in greater detail hereinafter, the operating mode categories generally include two or three specific operating modes. An operator may select an individual operating mode or combination of operating modes as desired.

### **A. Stranger Modes**

In general, stranger modes are used to process a stack of notes expected to be of the same denomination, in which the operator desires to remove “stranger” notes, or notes not having the same denomination. For example, a stranger mode may be selected to process a stack of notes substantially comprised of \$10 bills so that all non-\$10 bills may be removed from the stack. In a stranger mode, the machine will process the stack and place the “target” \$10 notes into a selected pocket (*e.g.*, pocket 1). Upon encountering a stranger note (or upon encountering another selected error condition), the machine may “present” the flagged note into the same pocket as the target note (*i.e.*, stop the machine after the flagged bill is delivered into an output pocket, *e.g.*, pocket 1) to allow the operator to inspect the note, or the machine may be programmed to off-sort the flagged note into the other pocket (*e.g.*, pocket 2). Upon off-sorting the stranger note into pocket 2, the machine may be designed to either stop (present the note into pocket 2) and allow the operator to inspect the note, or continue processing the remaining notes in the stack.

A display, such as a touch panel display (*e.g.*, FIG. 1), may indicate the number or aggregate value of notes having the target denomination, *e.g.*, \$10 bills. In one embodiment, the display is also capable of including totals associated with stranger notes via operator selection choices. For example, if a \$5 stranger bill is detected in a stack of \$10 bills, the operator may be prompted via the display as to whether the \$5 bill should be incorporated into the running totals. If the operator responds positively, the \$5 bill is incorporated into appropriate running totals, otherwise it is not. Alternatively, a set-up selection may be chosen whereby all stranger notes are automatically incorporated into appropriate running totals. The machine may include the following stranger modes as described below: stranger 1, stranger 2, stranger facing and stranger orientation.

### **1. Stranger 1 (STR 1)**

In "Stranger 1" mode, the discriminator will process a stack of notes and place notes having a target denomination into pocket 1. The target denomination may be selected automatically by the discriminator to be that of the first note in the stack, or the target denomination may be explicitly selected by the operator. Upon the occurrence of a "stranger" condition (*i.e.*, upon encountering a note not having the target denomination), the system may either present the flagged note into pocket 1 or off-sort the flagged note into pocket 2. Depending upon the set-up selected, the machine may either present the off-sorted flagged bill or continue processing bills. Optionally, the system may be similarly programmed to either present or off-sort flagged notes upon the occurrence of the "no call", "separate series", or "suspect document" conditions (minor errors). Upon encountering either the "strap limit", "stacker full", "chain", "double" or "jam" condition, the machine will stop, requiring the operator to undertake the appropriate corrective action before continuing such as removing bills from a full pocket or clearing a jam.

### **2. Stranger 2 (STR 2)**

In "Stranger 2" mode, as in "Stranger 1" mode, the discriminator will process the stack and place notes having a target denomination into pocket 1. Upon encountering either the "strap limit" or "stacker full" condition, however, the machine will automatically begin delivering the target notes to pocket 2 provided that pocket is empty. Thereafter, upon encountering the "strap limit" or "stacker full" conditions again, the machine will automatically switch pockets and begin delivering bills into the other pocket if the other pocket has been cleared by the operator. If the other pocket has not been cleared, the machine will stop, requiring the operator remove the bills from either pocket 1 or pocket 2 before continuing. The display may indicate the aggregate value of the notes in the stack and/or the value or number of notes of each denomination in either pocket 1 or pocket 2.

Upon the occurrence of a minor error condition such as "stranger" (when the other pocket has not been cleared), no call, suspect document or separate series, the system may either present the flagged note into the current pocket or off-sort the flagged note into the other pocket and stop (*i.e.*, present the flagged note in the other pocket). Alternatively, the system may be set to always present flagged notes into a given pocket (*e.g.*, pocket 2) regardless of which pocket is the current pocket. Major errors will cause the machine to stop



and the operator to take appropriate corrective action such as clearing a jam and/or re-processing a stack of notes.

### **3. Stranger Facing (STR F)**

In "Stranger Facing" mode, the machine is designed to process a stack of notes faced  
 5 in substantially the same direction, *e.g.*, placed in the input hopper face up, and to detect any  
 notes facing the opposite direction. The ability to detect and correct for reverse-faced notes is  
 important as the Federal Reserve requires currency it receives to be faced in the same  
 direction. Thus, in "Stranger Facing" mode, the discriminator will process a stack of notes  
 and place notes faced in a target direction and having a target denomination into pocket 1.  
 10 The target direction and denomination may be selected automatically by the discriminator to  
 be that of the first note in the stack, or the target direction and/or denomination may be  
 explicitly selected by the operator. Upon the occurrence of a "stranger" condition (*i.e.*, upon  
 encountering a note having a denomination other than the target denomination) or upon the  
 occurrence of a "reverse-faced" condition (*i.e.*, upon encountering an opposite-faced note of  
 15 the target denomination), the machine will either present the flagged note into pocket 1 or  
 pocket 2 or off-sort the flagged note into pocket 2 and continue processing notes. Minor  
 errors such as "suspect document", "no call", or "separate series" may be handled as discussed  
 above, such as by presenting a flagged bill into either pocket 1 or pocket 2 or off-sorting into  
 pocket 2 and continuing to process bills. For example, target notes may be delivered to  
 20 pocket 1 and all other notes (strangers, no calls, suspect, separate series, reverse-faced) may  
 be delivered to pocket 2. These bills may be simply off-sorted to pocket 2 and the machine  
 may continue to process successive notes. Alternatively, one or more of the above conditions  
 may be presented into pocket 2 (*e.g.*, no calls and suspects may cause the machine to halt and  
 appropriate messages to be displayed while strangers and reverse-faced notes are simply off-  
 25 sorted but not presented).

According to another embodiment, notes having the target denomination and face  
 orientation are delivered to one pocket (*e.g.*, pocket 1) and notes having the target  
 denomination but not the target face orientation are delivered to the other pocket (*e.g.*, pocket  
 2). Only notes not having the target denomination are treated as stranger notes and may be  
 30 handled by being presented into one of the pockets. Likewise, minor errors such as "suspect  
 document", "no call", or "separate series" may be handled by presenting a flagged bill into  
 either pocket 1 or pocket 2.

“Stacker full” or “strap limit” conditions may be handled by stopping and waiting for the operator to clear one or both pockets. The “strap limit” may be set up on a pocket by pocket basis or based on the combined contents of pockets 1 and 2. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).

#### 5            **4. Stranger Orientation (STR O)**

In “Stranger Orientation” mode, the machine is designed to process a stack of notes faced in substantially the same forward/reverse orientation, *e.g.*, in a predetermined forward or reverse orientation direction. The forward direction may be defined as the feed direction whereby the top edge of a note is fed first and conversely for the reverse direction. The ability to detect and correct for reverse-oriented notes is important as the United States Federal Reserve may soon require currency it receives to be oriented in the same forward/reverse direction. Thus, in “Stranger Orientation” mode, the discriminator will process a stack of notes and place notes having a target forward/reverse orientation and having a target denomination into pocket 1. The target orientation and denomination may be selected automatically by the discriminator to be that of the first note in the stack, or the target direction and/or denomination may be explicitly selected by the operator. Upon the occurrence of a “stranger” condition (*i.e.*, upon encountering a note having a denomination other than the target denomination) or a “reverse-oriented” condition (*i.e.*, upon encountering an opposite-oriented note of the target denomination), the machine will either present the flagged note into pocket 1 or pocket 2 or off-sort the flagged note into pocket 2 and continue processing notes. Minor errors such as “suspect document”, “no call”, or “separate series” may be handled as discussed above, such as by presenting a flagged bill into either pocket 1 or pocket 2 or off-sorting into pocket 2 and continuing to process bills. For example, target notes may be delivered to pocket 1 and all other notes (strangers, no calls, suspect, separate series, reverse-oriented) may be delivered to pocket 2. These bills may be simply off-sorted to pocket 2 and the machine may continue to process successive notes. Alternatively, one or more of the above conditions may be presented into pocket 2 (*e.g.*, no calls and suspects may cause the machine to halt and appropriate messages to be displayed while strangers and reverse-oriented notes are simply off-sorted but not presented).

30            According to another embodiment, notes having the target denomination and orientation are delivered to one pocket (*e.g.*, pocket 1) and notes having the target denomination but not the target orientation are delivered to the other pocket (*e.g.*, pocket 2).

Only notes not having the target denomination are treated as stranger notes and may be handled by being presented into one of the pockets. Likewise, minor errors such as “suspect document”, “no call”, or “separate series” may be handled by presenting a flagged bill into either pocket 1 or pocket 2.

5           “Stacker full” or “strap limit” conditions may be handled by stopping and waiting for the operator to clear one or both pockets. The “strap limit” may be set up on a pocket by pocket basis or based on the combined contents of pockets 1 and 2. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).

## 10    **B. Sort Modes**

          Generally speaking, sort modes are designed to accommodate a pre-sorted stack of notes having a “rainbow” configuration, *e.g.*, wherein the stack of notes includes two or more groups of notes, each group having a different denomination but each note within a given group having the same denomination. For example, the stack of notes may be pre-sorted to  
15   include a group of \$1 bills at the beginning of the stack, followed by a group of \$5 bills, followed by a group of \$10 bills, etc. Sort modes permit a user to separate such a “rainbow” stack of notes into separate stacks according to denomination. Alternatively, sort modes may be used to sort a mixed stack of notes, *e.g.*, not pre-sorted, into separate stacks according to denomination.

20           For example, in a sort mode, the machine may process a stack of notes and deposit a first group of “target” notes (*e.g.*, \$1 bills) into a selected pocket. Upon encountering a “denomination change” condition (or upon encountering another selected flagging condition), the machine may “present” the flagged note into the same pocket as the target note and stop to allow the operator to inspect the note, or the machine may be programmed to off-sort the  
25   flagged note into the other pocket. Upon off-sorting the denomination change note or other flagged note into pocket 2, the machine may be designed to either stop and allow the operator to inspect the note or to continue processing the remaining notes in the stack.

          As described in relation to stranger modes above, the discrimination system may include a display to indicate the number or aggregate value of notes of each respective  
30   denomination and/or the number or aggregate value of notes in the stack. The machine may include the following sort modes as described below: sort 1, sort 2, sort 3, sort facing and sort orientation.

### **1. Sort 1 (SRT 1)**

In “Sort 1” mode, the discriminator is designed to process a stack of notes and place notes having a first target denomination (*e.g.*, target denomination 1) into pocket 1 and a second target denomination (*e.g.*, target denomination 2) into pocket 2. The target denominations may be selected by the operator prior to sorting through a stack, or may be selected automatically by the discriminator, *e.g.*, the first encountered denomination being designated target denomination 1 and the second encountered denomination being designated target denomination 2.

Where target denominations are set by the operator, bills of target denomination 1 are delivered into pocket 1 and bills of target denomination 2 are delivered to pocket 2. Bills having a denomination other than target denomination 1 or 2 are flagged. The flagged bills are presented into either pocket 1 or pocket 2.

For example, in one embodiment, the discriminator automatically designates the first target denomination (target note 1) to be that of the first note in the stack, then proceeds to deliver target note 1 to pocket 1. Upon encountering a “denomination change” condition, the discriminator flags the note, designates the flagged note as the second target denomination (target note 2) and delivers target notes 2 to pocket 2. Thereafter, upon encountering another “denomination change” condition, if the appropriate pocket has been cleared by the operator, the machine will proceed to deliver the third denomination of bills into pocket 1, the fourth denomination of bills into pocket 2, and so on. If the appropriate pocket has not been cleared, the machine will stop upon a “denomination change” condition, requiring the operator remove the bills from the appropriate pocket before continuing.

Upon encountering other minor errors such as “no call”, “suspect document”, and “separate series”, the machine will stop, presenting the flagged bills into one of the pockets.

“Stacker full” or “strap limit” conditions may be handled by stopping and waiting for the operator to clear one or both pockets. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).

For example, in an embodiment in which the discriminator automatically selects the target denominations, if the first note in the stack is a \$1 bill, the machine will designate target note 1 as a \$1 bill and deliver \$1 bills into pocket 1 until encountering the first non-\$1 bill. The first non-\$1 bill, which for example may be a \$5 bill, is then designated as target note 2 and is delivered to pocket 2. Then, if and when the discriminator encounters a bill having a third denomination, which for example may be a \$10 bill, the machine will either direct any

subsequent \$10 bills into pocket 1, or will stop if necessary to allow the operator to clear pocket 1. The machine may be designed to automatically resume operation delivering subsequent \$10 bills into pocket 1 when the operator removes all the bills present in pocket 1. Assuming that pocket 1 is clear, the machine will then deliver \$10 bills into pocket 1 until  
 5 encountering the next series of bills, and so on until the entire stack has been processed.

## **2. Sort 2 (SRT 2)**

In "Sort 2" mode, the discriminator will process a stack of notes and place notes having a target denomination into pocket 1. The target denomination may be selected automatically by the discriminator to be that of the first note in the stack, or the target  
 10 denomination may be selected by the operator. Upon the occurrence of the "denomination change" condition (*e.g.*, upon encountering a note not having the target denomination), the system will "present" the flagged note into pocket 1 and stop to allow the operator to inspect the note. Alternatively, the system may be programmed to present "denomination change" notes in pocket 2.

15 Upon encountering other minor errors such as "no call", "suspect document", and "separate series", the machine will stop, presenting the flagged bills into one of the pockets. Alternatively, one or more of these conditions may cause flagged bills to be off-sorted into pocket 2 without causing the system to stop. The system may permit the operator to select how these bills are to be handled via a set-up option.

20 "Stacker full" or "strap limit" conditions may be handled by stopping and waiting for the operator to clear one or both pockets. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).

For example, in an embodiment in which the discriminator automatically selects the target denominations, if the first note in the stack is a \$1 bill, the machine will designate \$1 as  
 25 the target note and will deliver \$1 bills into pocket 1 until encountering the first non-\$1 bill. The first non-\$1 bill, which may for example be a \$5 bill, will then be "presented" into pocket 1. The operator may then remove all \$1 bills from pocket 1 and then select an appropriate continuation key. If the first note in the remainder of the stack is also a \$5 bill, the machine will designate \$5 as the new target note and will proceed to deliver \$5 bills into pocket 1 until  
 30 encountering the first non-\$5 bill, and so on until the entire stack has been processed. If the first note in the remainder of the stack is not a \$5 bill, then a denomination change error will occur and the machine will present the non-\$5 bill into pocket 1, and so on. According to

another embodiment, after a denomination change note is presented into pocket 1, the machine restarts automatically when the operator removes all the bills in pocket 1. The operator may then separate the bills by denomination (*e.g.*, place all \$1 bills into one stack and the last \$5 bill into its own stack).

### 5            **3. Sort 3 (SRT 3)**

In “Sort 3” mode, the discriminator will process a stack of notes and place notes having a target denomination into pocket 1, as in the Sort 2 mode. However, upon the occurrence of the “denomination change” condition, the system will off-sort the flagged note into pocket 2 rather than present the flagged note into pocket 1. The system may or may not be designed to stop after encountering non-target notes, *i.e.*, “denomination change” notes.

10            According to one embodiment notes having a target denomination (target 1) are delivered to pocket 1. Upon encountering a first denomination change, the denomination of the first non-target 1 note is designated as a target 2 denomination (target 2). Target 2 notes and then off-sorted into pocket 2 without causing the machine to stop. The machine continues to process notes, delivering target 1 notes to pocket 1 and target 2 notes to pocket 2, until the first note having a denomination other than target 1 denomination or target 2 denomination is encountered. At this point this third denomination note is designated as the “new” target 2 denomination and is directed toward pocket 2. According to one embodiment this third denomination note is delivered to pocket 2 and the machine is stopped with the display indicating a denomination change in pocket 2. The operator can then take the appropriate action such as removing all notes in pocket 2 (*e.g.*, in an automatic restart configured set up) or remove all bills other than the third denomination bill and press a continuation key. The machine will then continue processing notes, continuing to deliver original target 1 notes to pocket 1 and delivering “new” target 2 notes to pocket 2, until encountering a bill having a denomination other than target 1 or the present target 2. At this point, a denomination change occurs as described above and a new target 2 denomination is designated.

20            According to another embodiment, when a new target 2 note is encountered, the transport mechanism stops before the new target 2 note is delivered into the second output receptacle and a denomination change in pocket 2 message is displayed. In this manner, when the machine stops, all the bills in pocket 2 have the same denomination. The operator may then remove all the bills in pocket 2 and set them aside. Depending on the set up, the machine may either resume operation automatically or resume upon the selection of a continuation key.

When the machine resumes, the new target note 2 is delivered into the now empty pocket 2 and the machine continues processing bills until encountering a “new” target note 2 denomination.

Upon encountering other minor errors such as “no call”, “suspect document”, and “separate series”, the machine will stop, presenting the flagged bills into one of the pockets. “Stacker full” or “strap limit” conditions may be handled by stopping and waiting for the operator to clear one or both pockets. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).

For example, in an embodiment in which the discriminator automatically selects the target denominations, if the first note in the stack is a \$1 bill, the machine will designate \$1 as the target note and will deliver \$1 bills into pocket 1 until encountering the first non-\$1 bill. The first non-\$1 bill, which may for example be a \$5 bill, will then be off-sorted into pocket 2. According to one embodiment, the machine then continues to process notes, delivering \$1 bills into pocket 1 and \$5 bills into pocket 2, until encountering the next denomination change (*i.e.*, a bill other than a \$1 or a \$5). Thereafter, upon encountering the next denomination change, such as a \$10 bill, the \$10 bills are designated as the new target 2 denomination and the system halts so that pocket 2 may be cleared. When the system resumes operation, the machine continues to process notes, delivering \$1 bills into pocket 1 and \$10 bills into pocket 2, until encountering the next denomination change (*i.e.*, a bill other than a \$1 or a \$10), and so on.

#### **4. Sort 4 (SRT 4)**

In “Sort 4” mode, the discriminator will process a stack of notes and place notes having a target denomination into pocket 1. All other notes are delivered to pocket 2. Thus, upon the occurrence of the “denomination change” condition, the system will off-sort the flagged note into pocket 2. The system then continues processing any remaining bills without stopping. According to one embodiment, only notes having the target denomination (pocket 1) are counted while all non-target notes are simply delivered to pocket 2 without being counted.

Upon encountering other minor errors such as “no call”, “suspect document”, and “separate series”, the machine may be programmed to stop, presenting the flagged bills into one of the pockets such as pocket 2. Alternatively, the machine may be programmed to effectively ignore one or more of the minor errors such as “no call”, “suspect document”, and

“separate series” and to simply off-sort such bills to pocket 2 and continue processing any remaining bills. For example, the system may be set-up to simply off-sort into pocket 2 and continue processing bills upon encountering a “no call” or “separate series” note while stopping and presenting any “suspect documents” into pocket 2. Thus in this example, the machine will quickly process an entire stack of bills, separating bills of a target denomination from all other notes in the stack. Apart from major errors and “stacker full” or “strap limit” conditions, the machine would only stop if a suspect document is encountered.

“Stacker full” or “strap limit” conditions may be handled by stopping and waiting for the operator to clear one or both pockets. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).

### **5. Sort Facing (SRT F)**

“Sort Facing” mode is substantially similar to “Stranger Facing” mode, the primary difference being the configuration of the stack of notes prior to processing. In “Sort Facing” mode, the stack of notes is generally pre-sorted into one or more groups of notes, each group being faced in a different direction, but each note within a given group facing the same direction and having the same denomination as other notes in that group, whereas in “Stranger Facing” mode, each note in the stack is expected to be faced in the same direction and have the same denomination. Thus, in “Sort Facing” mode, the discriminator will process the stack and place notes of a target denomination faced in a target direction into pocket 1. Upon encountering a target denomination but reverse-faced note (*i.e.*, a reverse-faced condition), the machine will either present the flagged note into pocket 1 or off-sort the flagged note into pocket 2. When the reverse-faced target note is off-sorted to pocket 2, the machine may either present this note into pocket 2 or continue processing notes. The system may permit the operator to select how these bills are to be handled via a set-up option (*e.g.*, present into pocket 1, present into pocket 2, or off-sort into pocket 2 and continue).

Upon encountering other minor errors such as “no call”, “suspect document”, and “separate series”, the machine will stop, presenting the flagged bills into one of the pockets. “Stacker full” or “strap limit” conditions may be handled by stopping and waiting for the operator to clear one or both pockets. The “strap limit” may be set up on a pocket by pocket basis or based on the combined contents of pockets 1 and 2. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).



## **6. Sort Orientation (SRT O)**

“Sort Orientation” mode is substantially similar to “Stranger Orientation” mode, the primary difference being the configuration of the stack of notes prior to processing. In “Sort Orientation” mode, the stack of notes is pre-sorted into one or more groups of notes, each group being oriented in a different direction, but each note within a given group having the same denomination and being oriented the same as other notes in that group. The discriminator will process the stack and place notes having the target denomination and being oriented in a target direction into pocket 1. Upon encountering a target denomination but reverse-oriented note (*i.e.*, a reverse-oriented condition), the machine will either present the flagged note into pocket 1 or off-sort the flagged note into pocket 2. When the reverse-oriented target note is off-sorted to pocket 2, the machine may either present this note into pocket 2 or continue processing notes. The system may permit the operator to select how these bills are to be handled via a set-up option (*e.g.*, present into pocket 1, present into pocket 2, or off-sort into pocket 2 and continue).

Upon encountering other minor errors such as “no call”, “suspect document”, and “separate series”, the machine will stop, presenting the flagged bills into one of the pockets. “Stacker full” or “strap limit” conditions may be handled by stopping and waiting for the operator to clear one or both pockets. The “strap limit” may be set up on a pocket by pocket basis or based on the combined contents of pockets 1 and 2. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).

## **7. Sort Series (SRT S)**

In “Sort Series” mode, the discriminator will process a stack of notes and place notes of a target series or group of series into pocket 1. Upon the occurrence of the “separate series” condition (*e.g.*, upon encountering a note not having the target series), the system will off-sort the flagged note into pocket 2. The system may be programmed to stop or not to stop after encountering non-target notes, *i.e.*, “separate series” notes. Alternatively, upon the occurrence of the “separate series” condition, the system may “present” the flagged note into pocket 1 and stop to allow the operator to inspect the note.

### **a. Update Pocket 2 Target - Denomination and Series**

For example, in an embodiment in which the discriminator automatically selects the target series and denomination, if the first note in the stack is a 1996-series \$100 bill, the

machine will designate 1996-series \$100 bills as the target note and will deliver 1996-series \$100 bills into pocket 1 until encountering the first non-1996-series \$100 bill. The first non-1996-series \$100 bill, which may, for example, be a 1995-series \$5 bill, will then be off-sorted into pocket 2. According to one embodiment, the machine then continues to process notes,  
 5 delivering 1996-series \$100 bills into pocket 1 and 1995-series \$5 bills into pocket 2, until encountering the next separate series condition (*i.e.*, a bill other than a 1996-series \$100 or a 1995-series \$5). Thereafter, upon encountering the next separate series condition, such as a 1995-series \$10 bill, the 1995-series \$10 bills are designated as the new target 2 series and the system halts so that pocket 2 may be cleared. When the system resumes operation, the  
 10 machine continues to process notes, delivering 1996-series \$100 bills into pocket 1 and 1995-series \$10 bills into pocket 2, until encountering the next separate series condition (*i.e.*, a bill other than a 1996-series \$100 or a 1995-series \$10), and so on.

**b. Update Target 1 - Denomination and Series**

15 According to another embodiment in which target notes are defined in terms of series and denomination and in which the discriminator automatically selects the target series and denomination, if the first note in the stack is a 1996-series \$100 bill, the machine will designate 1996-series \$100 as the target series and denomination and will deliver 1996-series \$100 bills into pocket 1 until encountering the first non-1996-series \$100 bill. The first non-1996-series  
 20 \$100 bill, which may for example be a 1995-series \$5 bill, will then be “presented” into pocket 1. The operator may then remove all 1996-series \$100 bills from pocket 1 and then select an appropriate continuation key. The machine will then designate 1995-series \$5 as the new target note and will proceed to deliver 1995-series \$5 bills into pocket 1 until encountering the first non-1995-series \$5 bill, and so on until the entire stack has been processed. If a note in  
 25 the remainder of the stack is not a 1995-series \$5 bill, then a separate series error will occur and the machine will present the non-1995-series \$5 bill into pocket 1, and so on. According to another embodiment, after a separate series note is presented into pocket 1, the machine restarts automatically when the operator removes all the bills from pocket 1. The operator may then separate the bills by denomination and series (*e.g.*, place all 1996-series \$100 bills  
 30 into one stack and the last 1995-series \$5 bill into its own stack). Minor errors such as “no calls” and “suspect documents” may be presented in pocket 2 or off-sorted into pocket 2 with the machine continuing to process bills.

c. **Update Pocket 2 Target - Series**

According to another embodiment, target notes are defined only by series or group of series regardless of denomination. According to one embodiment, notes having a target series (target 1) are delivered to pocket 1. Upon encountering a first separate series condition, the series of the first non-target 1 note is designated as a target 2 series (target 2). Target 2 notes are then off-sorted into pocket 2 without causing the machine to stop. The machine continues to process notes, delivering target 1 notes to pocket 1 and target 2 notes to pocket 2, until the first note having a series other than target 1 series or target 2 series is encountered. At this point this third series note is designated as the “new” target 2 series and is directed toward pocket 2. According to one embodiment this third series note is delivered to pocket 2 and the machine is stopped with the display indicating a series change in pocket 2. The operator can then take the appropriate action such as removing all notes in pocket 2 (*e.g.*, in an automatic restart configured set up) or remove all bills other than the third series bill and press a continuation key. The machine will then continue processing notes, continuing to deliver original target 1 notes to pocket 1 and delivering “new” target 2 notes to pocket 2, until encountering a bill having a series other than target 1 or the current target 2. At this point, a separate series condition occurs as described above and a new target 2 series is designated.

According to another embodiment, when a new target 2 note is encountered, the transport mechanism stops before the new target 2 note is delivered into the second output receptacle and a series change in pocket 2 message is displayed. In this manner, when the machine stops, all the bills in pocket 2 have the same series. The operator may then remove all the bills in pocket 2 and set them aside. Depending on the set up, the machine may either resume operation automatically or resume upon the selection of a continuation key. When the machine resumes, the new target note 2 is delivered into the now empty pocket 2 and the machine continues processing bills until encountering a “new” target note 2 series.

Upon encountering other minor errors such as “no call” and “suspect document”, the machine will stop, presenting the flagged bills into one of the pockets. “Stacker full” or “strap limit” conditions may be handled by stopping and waiting for the operator to clear one or both pockets. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).

For example, in an embodiment in which the discriminator automatically selects the target series, if the first note in the stack is a 1996-series \$100 bill, the machine will designate 1996-series bills as the target series and will deliver all 1996-series bills into pocket 1 until

encountering the first non-1996-series bill. The first non-1996-series bill, which may for example be a 1995-series \$5 bill, will then be off-sorted into pocket 2. According to one embodiment, the machine then continues to process notes, delivering 1996-series bills into pocket 1 and 1995-series bills into pocket 2, until encountering the next separate series condition (*i.e.*, a bill other than a 1996-series or a 1995-series note). Thereafter, upon encountering the next separate series condition, such as a 1993-series \$20 bill, 1993-series bills are designated as the new target 2 series and the system halts so that pocket 2 may be cleared. The machine then continues to operate in a similar manner as described in the paragraph entitled "Update Pocket 2 Target - Denomination and Series."

**d. Update Target 1 - Series**

According to another embodiment in which target notes are defined only by series or group of series regardless of denomination and in which the discriminator automatically selects the target series and denomination, if the first note in the stack is a 1996-series \$100 bill, the machine will designate 1996-series as the target series and will deliver all 1996-series bills into pocket 1 until encountering the first non-1996-series bill. The first non-1996-series bill, which may for example be a 1995-series \$5 bill, will then be "presented" into pocket 1. The machine then continues to operate in a similar manner as described in the above paragraph entitled "Update Target 1 - Denomination and Series" designating 1995-series notes as the new target series. Minor errors such as "no calls" and "suspect documents" may be presented in pocket 2 or off-sorted into pocket 2 with the machine continuing to process bills.

According to another embodiment, target series are defined by series or group of series without regard to denomination. Moreover, factory default or user defined series categories may be defined. For example, a "new series" group may be defined to include all bills having a series of 1996 or later. This group may include for example, 1996-series \$100s and 1997-series \$50s and \$20s). An "old-series" group may be defined as all other bills. Alternatively, a "series 1" group may be defined to include, for example, all 1996-series and later \$100s, all 1997-series and later \$50s and \$20s, and all \$1s, \$2, \$5, and \$10 regardless of series). Likewise, an accompanying "series 2" group may be defined to include all pre-1996-series \$100s and all pre-1997-series \$50s and \$20s. Using series 1 or series 2 in one of the above described series mode embodiments will permit the separation of all "old" series \$100s, \$50s, and \$20s from all other bills. Such an embodiment facilitates in the culling of all bills that are

to be removed from circulation. As additional “new” series bills enter circulation (*e.g.*, a 1999-series \$10 bill), the definitions of series 1 and series 2 may then be modified so that all bills that are to be removed from circulation may be easily culled from all other bills.

For example, a series group (Series A) may be defined as all bills having a series of 1995 or later. According to one embodiment, Series A is designated as the target series and all Series A notes are delivered to pocket 1 and all non-Series A bills are off-sorted to pocket 2. The machine may or may not be programmed to halt when a non-Series A note is encountered. Where the machine is not programmed to halt, a stack of bills may be quickly processed and separated into a group consisting of all 1995 and later series notes (pocket 1) and all pre-1995 series notes (pocket 2).

### **C. Mixed Modes**

Generally speaking, mixed modes are designed to accommodate a stack of notes having a “mixed” configuration, *e.g.*, including two or more denominations of notes in no particular order, where the operator desires to determine the number or aggregate value of notes of each respective denomination and/or the number or aggregate value of notes in the stack. Mixed modes “Mix 1”, “Mix 2”, “Mixed Facing” and “Mixed Orientation”, each of which will be described below. As with stranger and sort modes, the discrimination system may include a display to indicate the number or aggregate value of notes of each respective denomination and/or the number or aggregate value of notes in the stack.

#### **1. Mixed 1 (Mix 1)**

In “Mix 1” mode, the discriminator will process the stack of mixed notes and will generally place the notes into pocket 1. However, upon the occurrence of the “no call” or “suspect document” condition, the discriminator will flag the note and either present the flagged note into pocket 1 or off-sort the flagged note into pocket 2. The system may permit the operator to select how these bills are to be handled via a set-up option (*e.g.*, present into pocket 1, present into pocket 2, or off-sort into pocket 2 and continue).

A “Stacker full” condition may be handled by stopping and waiting for the operator to clear the full pocket. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).

## **2. Mixed 2 (Mix 2)**

In “Mix 2” mode, as in “Mix 1” mode, the discriminator will process the stack and begin placing notes into pocket 1 until encountering a “no call” or “suspect document” condition, in which case the discriminator will flag the note and present the flagged note into  
5 either pocket 1 or pocket 2. The system may permit the operator to select how these bills are to be handled via a set-up option (*e.g.*, present into pocket 1 or present into pocket 2).

Upon encountering the “stacker full” condition, however, the machine will not stop, as in “Mix 1” mode, but instead will automatically begin delivering the notes to pocket 2.

Thereafter, upon encountering the “stacker full” condition in pocket 2, the machine will again  
10 switch pockets and begin delivering bills into pocket 1 if pocket 1 has been cleared by the operator. If pocket 1 has not been cleared and the “stacker full” condition thereby exists in both pockets 1 and 2, the machine will stop, requiring the operator to remove the bills from either pocket 1 or pocket 2 before continuing.

Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2  
15 mode).

## **3. Mixed Facing (Mix F)**

In “Mixed Facing” mode, the discriminator will process a stack of mixed notes and place notes faced in a target direction into pocket 1. Upon encountering a reverse-faced note, the machine will either present the reversed-faced note into pocket 1 or off-sort the reverse-  
20 faced note into pocket 2. The system may permit the operator to select how these bills are to be handled via a set-up option (*e.g.*, present into pocket 1, present into pocket 2, off-sort into pocket 2 and continue).

Upon encountering a “no call” or “suspect document” condition, the discriminator will flag the note and either present the flagged note into pocket 1 or off-sort the flagged note into  
25 pocket 2. The system may permit the operator to select how these bills are to be handled via a set-up option (*e.g.*, present into pocket 1, present into pocket 2, off-sort into pocket 2 and continue). Where reverse-faced notes are being off-sorted into pocket 2 without causing the machine to halt, no calls and suspect documents should be presented into either pocket 1 or pocket 2.

30 The machine will stop, requiring the operator to remove the bills from the appropriate pocket before continuing, upon encountering a “stacker full” condition. Major errors are handled as discussed above (see, *e.g.*, discussion of the stranger 2 mode).

#### **4. Mixed Orientation (Mix O)**

In “Mixed Orientation” mode, the discriminator will process a stack of mixed notes and place notes oriented in a target direction into pocket 1. Upon encountering a reverse-oriented note, the machine will either present the flagged note into pocket 1 or off-sort the  
 5 flagged note into pocket 2. The system may permit the operator to select how these bills are to be handled via a set-up option (*e.g.*, present into pocket 1, present into pocket 2, off-sort into pocket 2 and continue).

Upon encountering a “no call” or “suspect document” condition, the discriminator will flag the note and either present the flagged note into pocket 1 or off-sort the flagged note into  
 10 pocket 2. The system may permit the operator to select how these bills are to be handled via a set-up option (*e.g.*, present into pocket 1, present into pocket 2, off-sort into pocket 2 and continue). Where reverse-oriented notes are being off-sorted into pocket 2 without causing the machine to halt, no calls and suspect documents should be presented into either pocket 1 or pocket 2.

15 The machine will stop, requiring the operator to remove the bills from the appropriate pocket before continuing, upon encountering the “stacker full” condition. Major errors are handled as discussed above (see *e.g.*, discussion of the stranger 2 mode).

#### **D. Count Mode (CNT)**

“Count Mode” is designed to accommodate a stack of notes in any configuration,  
 20 where the operator desires to determine the number or total value of notes in a stack. The discriminator will process the stack, placing notes into pocket 1 until encountering a “stacker full” or “strap limit” condition, in which case the discriminator will automatically begin to place the notes into pocket 2. Thereafter, upon encountering the “stacker full” or “strap limit” condition in pocket 2, the machine will again switch pockets and begin delivering bills into  
 25 pocket 1 if pocket 1 has been cleared by the operator. If pocket 1 has not been cleared and the “stacker full” or “strap limit” condition thereby exists in both pockets 1 and 2, the machine will stop, requiring the operator to remove the bills from either pocket 1 or pocket 2 before continuing. Count mode may operate in either a unit mode or a value mode. In the unit mode, notes are simply counted and the total number of notes is communicated. In the value  
 30 mode, the values of notes are totaled and the total value is communicated. Likewise, strap limits may be defined in terms of a unit or piece count (*e.g.*, 100 notes) or in terms of a total value (*e.g.*, \$200 notes in notes).

The machine will also stop, requiring the operator to remove the bills from the appropriate pocket, upon encountering a "suspect document" condition. Major errors are handled as discussed above (see, *e.g.*, discussion of the stranger 2 mode).

FIGs. 41 and 42 summarize some embodiments of the above described modes. For example, in Stranger 1 mode (STR 1), bills having a target denomination are delivered into pocket 1. Chains (C), Jams (J), and Doubles (D) cause the machine to halt with chain, jammed, and doubled bills being directed to pocket 1. Also, strap limits (SL) and stacker full (SF) errors in pocket 1 cause the machine to halt. Strangers (S), No Calls (NC), Separate Series (SS), and Suspect (SD) bills may be optionally directed to either pocket 1 or pocket 2 depending on user selections.

Each of the above operating modes is designed to be selectively activated, either individually or in combination, by an operator. In one embodiment of the present invention, the operating modes may be activated through a control panel. FIG. 19 is a front view of a control panel 61 according to one embodiment of the present invention. The control panel 61 comprises a keypad 62 and a display section 63. The keypad 62 comprises a plurality of keys including seven denomination selection elements 64a-64g, each associated with one of seven U.S. currency denominations, *i.e.*, \$1, \$2, \$5, \$10, \$20, \$50, and \$100. For foreign bill discriminators, the denomination selection elements may be labeled according to the currency system which a discriminator is designed to handle, and accordingly, there may be more or less than seven denomination selection elements. The \$1 denomination selection key 64a also serves as a mode selection key. The keypad 62 also comprises a "Continuation" selection element 65. Various information such as instructions, mode selection information, authentication and discrimination information, individual denomination counter values, and total batch counter value are communicated to the operator via an LCD 66 in the display section 63.

According to another embodiment, a touch screen is employed to display selection elements for selection by the operator as well as to display various messages to the operator including status and error conditions. Additionally, the touch screen input/output device may be employed to provide on-line help information to the operator, for example, to explain an operation feature or how to handle a given error condition. An example of a touch screen is illustrated in FIG. 20. The touch screen I/O device 556 includes a touch screen 560 mounted over a graphics display 561. In one embodiment, the display 561 is a liquid crystal display (LCD) with backlighting. The display may have, for example, 128 vertical pixels and 256



horizontal pixels. The display 561 contains a built-in character generator which permits the display 561 to display text and numbers having font and size pre-defined by the manufacturer of the display. Moreover, a controller such as a CPU is programmed to permit the loading and display of custom fonts and shapes (*e.g.*, key outlines) on the display 561. The display 561 is commercially available as Part No. GMF24012EBTW from Stanley Electric Company, Ltd., Equipment Export Section, of Tokyo, Japan.

The touch screen 560 may be an X-Y matrix touch screen forming a matrix of touch responsive points. The touch screen 560 includes two closely spaced but normally separated layers of optical grade polyester film each having a set of parallel transparent conductors. The sets of conductors in the two spaced polyester sheets are oriented at right angles to each other so when superimposed they form a grid. Along the outside edge of each polyester layer is a bus which interconnects the conductors supported on that layer. In this manner, electrical signals from the conductors are transmitted to the controller. When pressure from a finger or stylus is applied to the upper polyester layer, the set of conductors mounted to the upper layer is deflected downward into contact with the set of conductors mounted to the lower polyester layer. The contact between these sets of conductors acts as a mechanical closure of a switch element to complete an electrical circuit which is detected by the controller through the respective buses at the edges of the two polyester layers, thereby providing a means for detecting the X and Y coordinates of the switch closure. A matrix touch screen 560 of the above type is commercially available from Dynapro Thin Film Products, Inc. of Milwaukee, Wisconsin.

As illustrated in FIG. 20, the touch screen 560 forms a matrix of ninety-six optically transparent switch elements having six columns and sixteen rows. The controller is programmed to divide the switch elements in each column into groups of three to form five switches in each column. Actuation of any one of the three switch elements forming a switch actuates the switch. The uppermost switch element in each column remains on its own and is unused.

Although the touch screen 560 uses an X-Y matrix of optically transparent switches to detect the location of a touch, alternative types of touch screens may be substituted for the touch screen 560. These alternative touch screens use such well-known techniques as crossed beams of infrared light, acoustic surface waves, capacitance sensing, and resistive membranes to detect the location of a touch. The structure and operation of the alternative touch screens are described and illustrated, for example, in U.S. Patent Nos. 5,317,140, 5,297,030,

5,231,381, 5,198,976, 5,184,115, 5,105,186, 4,931,782, 4,928,094, 4,851,616, 4,811,004, 4,806,709, and 4,782,328, which are incorporated herein by reference in their entirety.

As described briefly above, one of the functions of the touch screen display is to display selection elements which may be selected by touching the portion of the screen associated with the selection element. The touch screen thereby serves in one respect as a “keyboard”, wherein the selection elements displayed on the screen represent “keys” that are activated by touching the associated area of the screen. Alternatively, it will be appreciated that a conventional keyboard may be used instead of or in addition to the touch screen keyboard to facilitate selection of various selection elements. At any rate, in embodiments using a touch screen, the touch screen display may display not only selection elements or “keys”, but also may display messages to the operator including status and error conditions of the discrimination system. Preferably, the configuration of the touch screen display is programmably changeable between several configurations, so that at any given time the touch screen will display only those “keys” or status and error conditions that are appropriate with respect to the present status of the discrimination system. For example, the touch screen may display a series of “menus” or “sub-menus”, each menu being associated with a particular mode of operation or status of the discrimination system and thereby including only those keys or display conditions appropriate to the particular mode or status of the discrimination system. The menu-driven approach is designed to simplify the “keyboard” for operators and reduce training times accordingly. The touch screen display may be programmed via computer software including set-up software, operation software and diagnostic software.

### **Set-Up Information**

The set-up software is designed to enable the operator to customize various operating parameters and engage or disengage various features of the discrimination system. The operating parameters may include, for example, default settings, stopping conditions, off-sort modes, pocket settings, denomination keys, stranger records or communications port settings. For example, a set-up mode may permit the user to identify which pocket is to receive no calls, suspect documents, mis-faced and mis-oriented documents, strangers, denomination changes, doubles, and chains or other bills or documents causing other types of minor or major errors. This information may be retrieved from the user via a routing interface having a data retrieval device such as a touch-screen. Alternatively, the data retrieval device may be some other kind of input or input/output device such as a keypad, buttons, or switches. Likewise,

the set-up mode may permit the user to define which pockets are to receive which kinds of documents and whether the system should stop upon the occurrence of various events, *e.g.*, various minor errors. Information concerning whether the system should stop upon the occurrence of one or more of the above conditions may be retrieved from the user via a

5 flagging control interface having a flagging data retrieval device such as a touch-screen.

Alternatively, the flagging data retrieval device may be some other kind of input or input/output device such as a keypad, buttons, or switches. The flagging control interface may be combined with the routing interface. Likewise the same touch-screen or input device may be used both to retrieve data concerning to which pockets various bills are to be directed as  
10 well as whether the system should stop upon the occurrence of one or more events such as the occurrence of one or more types of minor errors. The features of the discrimination system which may be engaged or disengaged in the set-up mode include operating modes, operating keys, sub-batching, suspect document authentication tests, stranger records, separate series discrimination, and/or audio alarms.

15 As described generally above, in a touch screen embodiment, the above-described operating features may be activated by touching selection elements or “keys” in respective “menus” associated with the operating features. Thus, in the set-up mode, the discrimination system may include the following:

(1) a key or keys which allows the customization of user-default settings or the  
20 selection of a factory default setting;

(2) a key which engages or disengages sub-batching;

(3) a key or keys which engage or disengage the operating modes, *e.g.*, STR 1, STR 2, STR F, STR O, SRT 1, SRT 2, SRT 3, SRT F, SRT O, Mix 1, Mix 2, MIX F, MIX O and Count;

25 (4) a key or key which engages or disengages the operating keys “Verify” (permits the machine to process bills without affecting existing totals), “Unit” (toggles between unit and value modes), “SD”, “Density”, “Add” (toggles between maintaining running totals and clearing running totals when the input hopper and both output pockets are cleared) or “Mode”;

30 (5) a key or keys which engages or disengages the audio alarms for the various error conditions, *e.g.*, Jam (J), Doubles (D), Chain (C), Stranger (S), Denomination Change (DC), No Call (NC), Suspect Document (SD), Separate Series (SS), Strap Limit (SL), or Stacker Full (SF);

(6) a key or keys which sets the use of denomination keys for the minor errors of no call (NC) and suspect document (SD);

(7) a key or keys which sets a stranger record (*i.e.*, sets whether the system should “record” or reflect in the appropriate counters the denomination/value of stranger notes);

5 (8) a key for enabling or disabling the SD minor error condition;

(9) a key for enabling or disabling the SS minor error condition;

(10) a key or keys for setting the configuration of communication ports;

(11) a key or keys for setting pockets for target notes, either manually or automatically;

10 (12) a key or keys for enabling or disabling the “off-sort” function or customizing stopping conditions related to the off-sort function (*e.g.*, present into pocket 1, present into pocket 2, off-sort and continue); and

(13) a key or keys for engaging or disengaging the “Face” and “Right” keys (the “Right” key is a forward/reverse orientation key).

15 When engaged in the set-up mode, pressing the “Face” key gives the user the ability to quick-face a stack of bills. The machine will deliver face-up bills to pocket 1 and face-down bills to pocket 2. Similarly, pressing the “Right” key gives the user the ability to quick-right a stack of bills. The machine will deliver “readable” bills, *e.g.*, wherein the words of the bill are right-side-up, to pocket 1 and non-readable bills, *e.g.*, wherein the words of the bill are  
20 upside-down, to pocket 2. Accordingly, the “Right” key causes bills having a forward orientation to be delivered to one pocket while causing bills having a reverse orientation to be delivered to the other pocket.

### **Operation Screens**

The operating software is designed to provide the operator with a series of menus or screens, each screen generally being associated with one or more modes of operation, *e.g.*, STR 1, STR 2, etc. As described above, in a touch screen embodiment, each of the screens include selection elements or “keys” which the operator may touch to activate appropriate functions related to the operating mode or status of the discriminator. The screens are further designed to display messages to the operator related to the operating modes such as, for example, batch or sub-batch totals and status or error conditions. Preferably, the touch screen at any given time will display only those “keys” or status and error conditions that are associated with the present status of the discrimination machine. FIG. 21 represents a “crossroad” or “main” touch screen associated with the a machine operating in “Stranger 1” (STR 1) mode. The hatched keys represent functions that are engaged. The touch screen contains the following keys and displays:

15	END (600)	This key ends either a sub-batch (by pressing once) or a batch (by pressing twice).
	ADD (601)	This key engages or disengages the Add function.
	VERFY (602)	This key allows for Verify mode operation.
	SD (603)	This key engages or disengages the Suspect Document (SD) minor error condition.
20	MODE (604)	This key engages the operating modes.
	MENU (605)	This key enables the operator to view totals, set strap limits, and SD and Density thresholds.
	RIGHT (606)	This key enables the operator to quick-right a stack of bills when this function is enabled in the set-up mode.
25	FACE (607)	This key enables the operator to quick-face a stack of bills when in this function is enabled in the set-up mode.
	S-BAT display (608)	This displays aggregate totals associated with a sub-batch of currency bills.
30	BAT display (609)	This displays aggregate totals associated with a batch of currency bills.
	MODE display (610)	This displays the selected mode of operation of the machine.
35	POCKET 1 display (611)	This displays the target note associated with pocket 1.
	POCKET 2 display (612)	This displays the notes associated with pocket 2.

From the screen shown in FIG. 21, in STR 1 mode, pressing the MODE key will produce the screen shown in FIG. 22, comprising a series of keys associated with the operating modes. Upon touching one of keys STR 1 (700), STR 2 (701), MIX 1 (702), MIX 2 (703), SORT 1 (704), SORT 2 (705), SORT 3 (706) or COUNT (707), the machine will transition directly to a display associated with the appropriate operating mode. For example, if an operator wishes to return to the STR 1 menu shown in FIG. 21, he or she simply executes a single "key stroke", touching either the EXIT key (708) or the STR 1 key (700). However, if an operator wishes to select one of the facing or orientation modes, SRT F, SRT O, STR F, STR O, MIX F or MIX O, he or she must execute two "key strokes", the first of which is to select one of keys SRT FO (709), STR FO (710) or MIX FO (711). Upon selecting one of these keys, the display shown in FIG. 23 will appear, prompting the operator to choose FACE (712) or ORIENT (713) in the associated mode. For example, in the display of FIG. 23, the operator has selected STR F mode, first by touching the STR FO key (710), then by touching the FACE key (712).

From the screen shown in FIG. 21, in STR 1 mode, pressing the MENU key (605) will produce the screen shown in FIG. 24, including BATCH (800), SUB BATCH (801), DAY (802), STRAP (803), SUSPECT DOCUMENT (804), DENSITY (805), UNIT (806) and EXIT (807) keys. Pressing the EXIT key (807) will bring the operator back to the main menu of FIG. 21. From this screen, pressing BATCH (800), SUB BATCH (801) or DAY (802) will produce a screen indicating totals for the appropriate key. For example, if an operator desires to obtain batch totals, he or she touches the BATCH key (800), which will produce the screen shown in FIG. 25. The screen shown in FIG. 25 indicates the number and aggregate value of each denomination of currency in the batch. Pressing the CLEAR key (810) in the screen of FIG. 25 will clear the appropriate totals and EXIT (811) will bring the operator back to the menu screen of FIG. 24.

From the menu screen (FIG. 24), pressing the STRAP key (803) will produce a screen (FIG. 26) within which strap limits may be set for various denominations of currency. Nine denominations can be accommodated for international markets. A highlighted cursor (900), indicated by hatching in FIG. 26, may be moved by the UP (901) and DOWN (902) keys at the right of the display to a particular denomination selected by the operator, e.g., \$5 in the example shown. Thereafter, strap limits may be set by touching one or more of the direct access keys (903a-g) at the bottom of the screen. For example, a strap limit of 100 may be

selected by touching the "100" key (903g). The "+" (904) and "-" (905) keys allow the operator to program the unit or limit at a custom amount, by incrementing or decrementing the displayed value. For example, the unit limit 38 may have been selected by first touching the "50" key (903e) and then touching the "-" key (905) twelve times. The CLEAR key (906) is designed to clear the limit and unit count associated with the highlighted line. Similarly, all the strap limits may be cleared by pressing ALL (907), then CLEAR (906). Pressing the UNIT key (909) toggles the display between presenting the information in unit form as shown in FIG. 26 and value form (*e.g.*, dollars). For example, if the UNIT key (909) were pressed in FIG. 26, then the word "UNIT" between "DENOM" and "LIMIT" would change to "VALUE" and the "38" for the \$5 line would change to "\$190" and the "100" for the \$5 line would change to "\$500". EXIT (908) will bring the operator back to the menu screen of FIG. 24.

From the menu screen (FIG. 24), pressing the SUSPECT DOCUMENT key (804) will produce a screen (FIG. 27) within which an operator may select threshold levels for triggering the "suspect document" minor error condition. Nine denominations can be accommodated for international markets. In the embodiment of FIG. 27, the system permits adjustment of three types of authentication tests, namely, a magnetic test, an ultraviolet (UV) test, and a fluorescence test. The magnetic test measures the total magnetic content of a document along a scan line. The ultraviolet test measures the amount of ultraviolet light that is reflected off a document when it is illuminated by an ultraviolet light source. The fluorescence test measures the amount of fluorescent light that is emitted from a document when it is illuminated by an ultraviolet light source. These tests and sensitivity adjustments are described in more detail in co-pending U.S. patent application Serial Nos. 08/494,091 filed on June 23, 1995 entitled "Currency Discriminator and Authenticator" and 08/317,349 filed on October 4, 1994 entitled "Method and Apparatus for Authenticating Documents Including Currency" which are incorporated herein by reference in their entirety. Likewise, the system may additionally include other authentication tests such as thread detection, enhanced magnetics tests including those employing a single and multiple magnetic heads, infrared detection, and color authentication tests including those described in co-pending U.S. patent application Serial No. 08/800,053, filed on February 14, 1997 entitled "Method and Apparatus for Document Identification and Authentication". These authentication tests may also employ multiple sensitivity setting by denomination and/or series.

A highlighted cursor (1000), indicated by hatching in FIG. 27, may be moved by the UP (1001) and DOWN (1002) keys and/or left and right arrow keys "<" (1003), ">" (1004) at the right of the display to a particular selected threshold. Thereafter, thresholds may be set by touching one or more of the direct access keys (1005a-k) at the bottom of the screen. The  
 5 OFF key (1005k) disables an authentication test. EXIT (1006) will bring the operator back to the menu screen of FIG. 24.

From the menu screen (FIG. 24), pressing the DENSITY key (805) will produce the screen shown in FIG. 28 within which an operator may select density levels associated with the various currency denominations. The density levels affects such functions as the detection  
 10 of two or more bills fed in a stacked manner (Doubles major error). Nine denominations can be accommodated for international markets. A highlighted cursor (1100), indicated by hatching in FIG. 28, may be moved by the UP (1101) and DOWN (1102) keys at the right of the display to a particular selected denomination. Thereafter, density levels may be set by touching one or more of the direct access keys (1103a-j) at the bottom of the screen. The OFF  
 15 key (1103k) disables density checking for the corresponding denomination. EXIT (1104) will bring the operator back to the menu screen of FIG. 24.

In one embodiment of the present invention, the display may be used to indicate recovery procedures upon the occurrence of an error condition that has stopped the machine. Error conditions can include for example, jam, double, chain, stacker full, strap limit,  
 20 denomination change, and stranger. Preferably, the recovery procedures are displayed in the form of text indicating both the error condition that has occurred and detailed instructions for the operator to follow to recover from the error condition and resume operation of the machine. For example, a jam can be identified by its location in the machine such as in pocket 1, pocket 2, infeed area, etc. Likewise, a display associated with a "strap limit" error  
 25 condition is shown in FIG. 29. The display "STRAP LIMIT POCKET 1" identifies that the machine has stopped due to a "strap limit" error condition in pocket 1. The display "REMOVE NOTES AND PRESS CONT." indicates to the operator that he or she must first remove the notes in pocket 1, then press the "CONT" key (1200) to resume operation of the machine.

30 A further example of a recovery screen is shown in FIG. 30, illustrating a display associated with a "no call" error condition. A screen substantially similar to FIG. 30 may also be used upon the occurrence of a "suspect document" condition. The display "NO CALL PRESS KEY:" indicates to the operator that the machine has stopped due to a "no call"



condition and that the operator may press one of the keys (1300a-g) in the display, *e.g.*, “\$1”, “\$2”, “\$5”, “\$10”, “\$20”, “\$50” or “\$100”, to resume operation of the machine. The operator may thereafter observe the denomination of the “no call” document and press the appropriate key (1300a-g) if the operator finds the bills to be acceptable, causing the machine to add the appropriate value to the count total and resume processing the remaining notes in the stack. If the operator finds the bill unacceptable (*e.g.*, suspect, a bill from a different country), the operator may press a CONT. key (1301) (Continue key). Generally, the operator will first remove the unacceptable bill from the output pocket first and then press the CONT. key (1301). The machine will then resume processing the remaining notes in the stack without improperly disrupting any running totals or counters.

In another embodiment of the present invention, the display may be used to enable the operator to enter data such as, for example, user identification, date, customized labels, check amounts, coin amounts, or manual bill counts. In a touch screen environment, this may be accomplished through data entry software providing a series of menus or screens, each including selection elements or “keys” which the operator may touch to activate appropriate functions related to one or more data entry modes. These features may be engaged in the set-up program described above, or they may be requested on demand. If used on demand, the “keys” should be displayed upon the beginning of processing a batch of notes. FIG. 31 represents a touch screen associated with the a machine in data entry mode. The hatched keys represent functions that are engaged. The touch screen contains the following keys and displays:

	LABEL (1401)	This key enables the operator to customize labels A,B,C,D through the touch panel keyboard.
25	ID (1402)	This key prompts the operator to enter a user identification code.
	MEDIA (1403)	This key prompts the operator to enter the media type associated with the data entry, <i>e.g.</i> , coin, check or misc.
	DATE (1404)	This key prompts the operator to enter the date.
30	DBAL (1405)	This key prompts the operator to enter a declared balance (Batch and Sub-batch).
	EXIT (1406)	This key returns the operator to the previous menu.
35	MODE display (1407)	This displays the selected mode of operation of the machine.

STRAP LIMIT display (1408)	This displays the strap limit associated with the mode of operation.
STRAP COUNT display (1409)	This displays the current number of a select document-type counted
5 DENOM display (1410)	This displays the selected document-type
SUB-BATCH display (1411)	This displays aggregate totals associated with a sub-batch of currency bills.
BATCH display (1412)	This displays aggregate totals associated with a batch of currency bills.

10

Pressing the MEDIA key (1403) will result in the screen shown in FIG. 32 being displayed. At this screen, the operator selects what type of media is to be recorded into the systems memory by selecting either a COIN key (1501), a CHECK key (1502), or a MISC key (1503). To return to the screen of FIG. 31, the operator would select the EXIT key (1504).

15

In the example shown in FIG. 32 the operator has indicated that the amount of a check is to be entered into the systems memory by selecting the CHECK key (1502). At this point, the screen shown in FIG. 33 appears and prompts the operator to enter the value of the check by displaying the message: "ENTER VALUE". The amount that operator the enters is displayed on the screen (1510). The operator may enter the amount by using a keyboard connected to or integrated into the machine such as that shown in FIG. 34. Alternatively, the keyboard of FIG. 34 may be displayed on the touch screen such as at area 1511 of FIG. 33. Once the operator has typed in the correct amount, it is entered into the memory of the system by selection of the ENTER key (1512). Data entry mistakes may be corrected by pressing the CLEAR key (1513). If the operator wishes to return to the previous screen (FIG. 32) without entering any amount, the EXIT key (1514) is selected. According to one embodiment, data entry as described above may be performed even while the system is processing a stack of notes. However, upon the occurrence of an error that requires presentation of other keys or functions to recover, data entry will be suspended until the machine resumes operation.

25

In one embodiment of the present invention, the discrimination machine is equipped with a series of communications ports to provide one-way or two-way communications link(s) between the discrimination machine and remote operators and/or other machines. This communications link may be established, for example, between another currency discrimination machine, a coin sorting machine, a cash settlement system, currency dispensers,

30

or a remote "host" device, such as a computer, for issuing control commands and/or receiving information from the discrimination machine.

In embodiments using a "host" device, the following commands may be issued from the host, to which the discrimination machine will respond operationally:

- 5 (1) a "START" command for starting operation of the machine;
- (2) a "REQUEST INFORMATION" command wherein the host may request information from the machine, such as sub-batch, batch, or day totals;
- (3) a "MODE SELECTION" command wherein the host may remotely select the mode of operation for the machine;
- 10 (4) an "ADD SELECTION" command;
- (5) an "SD" selection command wherein the host may remotely set sensitivity thresholds for the machine;
- (6) a "STRAP SETTINGS" command;
- (7) a "CLEARING" command;
- 15 (8) a "DENSITY SETTING" command;
- (9) a "POCKET SELECTION" command; and
- (10) an "ENDING BATCH" command.

In return, in embodiments using a "host" device, it is contemplated that the discrimination machine may send the following information to the host:

- 20 (1) a message or messages indicating the occurrence of minor error condition(s) "NO CALL", "SUSPECT DOCUMENT", "DENOMINATION CHANGE", "STRAP LIMIT", "STRANGER", "STACKER FULL" or "SEPARATE SERIES";
- (2) a message or messages indicating the occurrence of major error conditions "JAM", "DOUBLE" or "CHAIN"; and
- 25 (3) maintenance messages indicating maintenance requirements or status of the machine, such as whether the machine requires cleaning or adjustment.

Many types of financial transaction features may be incorporated into the above described machines so that they can act as a cash settlement machine. The details of such cash settlement systems are described in more detail in co-pending United States patent application Serial No. 08/467,585, filed on June 6, 1995 for a "Cash Settlement Machine" incorporated herein by reference in its entirety.

While many of the above embodiments have been described in conjunction with U.S. currency, systems according to the present invention may alternatively or additionally process currency of other countries such as the United Kingdom, France, Germany, Japan, Spain,

Canada, Italy, Brazil, Mexico, Taiwan, and Saudi Arabia. Likewise, the above systems may support the processing of multiple types of documents including, for example, checks, deposit slips, header documents, etc.

5 Additionally, the systems described above may contain fitness sensors such as density sensors, reflectance sensors, magnetic sensors, correlation, UV and soil sensors, tear detectors, etc. Also the systems may utilize flash memory as mentioned above and E<sup>2</sup> prompts for reliable storage of data and set ups.

10 Additionally, the systems described above may contain unique customization features such as user-defined keys, user-defined print outs, user-defined modes of operation, user-defined document distribution parameters, user-defined set-ups. The customization features may be controlled or changed through simple input through an interface device such as a keyboard or touch screen.

### **User Customization**

15 As described above and as to be further described below, according to embodiments of the present invention, the system permits the user or operator to customize the operation of the machine in a number of ways. For example, in the above described modes of operation, the user may be permitted to designate into which pocket certain bills are delivered and whether the machine should stop, *e.g.*, deliver any no calls into pocket 2 and stop the machine  
20 after each no call is delivered to pocket 2. Additional examples of how the user may customize a system according to the present invention are described in connection with FIGs. 35-40. FIGs. 35-40 illustrate examples of displays designed to aid the operator in tailoring the operation of the machine according to the operator's preferences. These figures illustrate displays that may be used to aid in retrieval of routing and flagging information from a user  
25 such as via a routing interface having a data retrieval device such as a touch-screen. Alternatively, the data retrieval device may be some other kind of input or input/output device such as a keypad. Additionally or alternatively, information concerning whether the system should stop upon the occurrence of one or more conditions may be retrieved from the user via a flagging control interface having a flagging data retrieval device such as a touch-screen.  
30 Alternatively, the flagging data retrieval device may be some other kind of input or input/output device such as a keypad. The flagging control interface may be combined with the routing interface into a single interface system.

FIG. 35 illustrates an example of an operating parameters selection screen in which no selections have been made. The left-hand column (C1) lists various features and conditions for which the operator may make selections. The right-hand column (C3) lists the available selection choices or options associated with each feature or condition and the middle column (C2) displays the selected option for each feature or condition (in FIG. 35 no selections have been made).

Turning to FIG. 36, an example of the operating parameters selection screen for a Stranger Facing mode is illustrated. In general, options which are not available are displayed in a non-highlighted or dim manner, illustrated in FIG. 36 via striking through unavailable options, *e.g.*, the “OFF” and “ALL” selection choices for the Target 1 denomination. Based on the selections displayed in FIG. 36, the system will deliver to pocket 1 bills having the same denomination and face orientation as the first bill in a stack. This is evident with reference to box C2,R1 which designates the target denomination as that of the “1st BILL”. Additionally, box C2,R2 designates a target face orientation as the face orientation of the “1st BILL”.

Neither forward/reverse orientation (“orientation”) nor “series” has been activated so bills are not distinguished on those bases. With respect to the designation of the Target 1 denomination, the operator may change the selection from “1st BILL” to a specific denomination, \$1 - \$100 or to User Select (US). If User Select is chosen, at the time the mode is invoked, the operator will be prompted as to the desired selection. In the case of selecting a denomination, any available option may be chosen such as “1st BILL” or a specific denomination. This may be accomplished, for example, by pressing the screen in box C2,R1 in a touch screen environment which will cause the displayed selection to scroll through the available options. Likewise, with respect to the designation of the target face orientation, the operator may scroll through the options of “1st BILL”, “FACE UP”, “FACE DOWN”, and “US”. In boxes C3, R1 and C3,R2 the option “OFF” is not available in a Stranger Facing mode.

With respect to forward/reverse orientation, the operator may choose either “OFF”, “1st BILL”, “FORWARD”, “REVERSE”, or “US”. With respect to series selection, the operator may choose either “OFF”, “1st BILL”, “US”, or scroll through any defined series groups such as those described above, *e.g.*, in connection with the Sort Series modes. These series groups may include factory-defined series groups and user-defined groups. Additionally, the operator may be given the option to simply designate a given series or range

of series, *e.g.*, "1996+" for all bills of a 1996 or later series or "1990-1996" for all bills having a series from 1990 to 1996.

In box C2,R5, the operator may designate whether the parameters defining Target 1 should be updated upon the occurrence of a relevant condition such as a denomination change, stranger, or separate series condition. The updating may be permitted, for example, for all activated parameters defining a target denomination (*e.g.*, denomination and face orientation in the example of FIG. 36) or alternatively, the user may elect to update only certain ones of the activated parameters (*e.g.*, update upon a stranger condition (new denomination) but not on a reverse face condition). As displayed in FIG. 36, the Target 1 parameters are not updated during the processing of a stack of bills.

In the Stranger Facing modes, the operator is not permitted to designate a second set of target parameters and accordingly this section (C2,R6 - C3,R10) of the display is dimmed.

Boxes C2,R11 - C2,R19 permit the operator to designate how certain minor error conditions are to be handled, *i.e.*, by presenting the flagged bill in pocket 1 (P1), presenting the flagged bill in pocket 2 (P2), or delivering the flagged bill to pocket 2 and continuing to process any remaining bills (CONT-2).

Additionally, for strangers, denomination changes, and separate series, the operator is also given the option of having the transport mechanism stopped with the flagged bill being maintained within the transport mechanism (ST), *i.e.*, before the flagged bill is delivered into a pocket. Positional information obtained from an encoder may be employed to stop a bill in a controlled manner and so that the bill is stopped in a predetermined position or identifiable location. For example, the transport mechanism may be stopped such that a flagged minor error bill is located after a diverter and before a next diverter or output receptacle such as between diverter 260 and output receptacle 217b such as being adjacent to plate 278 of FIG.

2. Alternatively, using the embodiment of FIG. 2 as an example, a flagged minor error bill may be stopped before reaching diverter 260 such as being adjacent to plate 262. One embodiment of a stopping mechanism employing an interconnected CPU, optical encoder, transport mechanism, and drive motor is described in U.S. Pat. No. 5,295,196 incorporated herein in its entirety. Likewise on a currency evaluation device having only a single output receptacle such as that describe in U.S. Pat. No. 5,295,196, a flagged minor error bill such as a stranger, denomination change, or separate series bill may be stopped so that it is located at a predetermined or identifiable position within the transport mechanism (*i.e.*, before being transport to the output receptacle).

As illustrated in FIG. 36, stranger bills, no calls, suspect documents, documents having an improper size, and unfit documents are all presented into pocket 2. Additionally, reverse faced notes are delivered to pocket 2 but do not cause the machine to halt operation.

Accordingly, bills having the target denomination and target face orientation are delivered into pocket 1 while bills having the target denomination but not the target face orientation are delivered to pocket 2. The error conditions of denomination change, reverse forward-reverse orientation, and separate series have been disabled by the choices selected above, *i.e.*, a denomination change error can not occur in a stranger mode, and by turning off orientation and series selections in boxes C2,R3 - C2,R4 orientation and series error conditions will not occur.

Boxes C2,R20 - C2,R23 permit the operator to set how stacker full, strap limit, chain, and double error conditions are handled. As illustrated in FIG. 36, the machine will stop upon the occurrence of a stacker full condition. Another option includes switching delivery of target notes to the non-current pocket when the current pocket becomes full provided there are no bills in the non-current pocket. Otherwise the machine will halt until one of the pockets is cleared. Box C2,R21 indicates that strap limits will be counted using the contents of both output pockets, *i.e.*, a strap limit will occur when the combined number of target denomination bills delivered to pocket 1 (having the target face orientation) and target denomination bills delivered to pocket 2 (having a reverse face orientation) reaches the limit associated with the target denomination. When either a chain or a double error condition occurs, the machine stops with any chain or double bills being delivered into pocket 2.

Turning to FIG. 37, an example of the operating parameters selection screen for a Sort 3 mode is illustrated. Here \$5 bills (having any face orientation, any forward/reverse orientation, or any series) are delivered to pocket 1 while the first non-\$5 bill becomes the second target denomination and is off-sorted into pocket 2. Thereafter \$5 bills are delivered to pocket 1 and target 2 denominated bills are delivered to pocket 2. Upon the occurrence of a denomination change, the denomination change bill will be presented into pocket 2 (C2,R12) and the denomination of the flagged bill will become the new target 2 denomination (C2,R10). The target 1 denomination will remain \$5 as box C2,R5 indicates that this denomination should not be updated.

Turning to FIG. 38, an example of the operating parameters selection screen for a first user defined mode is illustrated. The system may permit the operator to set a number of personalized operating modes (*e.g.*, user-defined 1, user-defined 2, etc.) Likewise the system

may permit user to define the name of the modes, *e.g.*, "Acme Bank Closing Mode", "Acme Bank Commercial Mode"). According to the selections made in FIG. 38, all face up \$100 bills having a series of 1996 or later are delivered into pocket 1 while all face down \$100 bills having a series of 1995 or earlier are delivered to pocket 2. When any possible minor error listed in rows R11-R19 occurs, the flagged bill is presented in pocket 2.

Information concerning user-defined modes is stored in a memory such as an E<sup>2</sup> PROM so that it can be recalled in the future such as on days subsequent to the day that it is original defined. This information is stored in such a manner that it is not lost after the power switch of the currency discriminator is turned off as in a nonvolatile memory. The definition of particular user-defined mode will remain unchanged until it is re-defined by a user of the currency discriminator. In this manner a user may define a mode of operation that is particularly adapted to the needs of the user and repeatedly recall that mode of operation whenever the user desires to operate the machine in that mode. For example, the operate could desire to process a stack of currency bills using one of the factory default modes such as the Mixed 1 mode of operation and then process of second stack of bills using an user-defined mode. In such a case, the operator would first select the factory mode desired such as Mixed 1, process the first stack of bills, then select the desired user-defined mode, and process the second stack of bills. The definitions of the factory-defined or default modes may also be stored in an E<sup>2</sup> PROM.

Turning to FIG. 39, an example of the operating parameters selection screen for a second user defined mode is illustrated. According to the selections made in FIG. 39, bills of all denominations (as in a mixed mode), are delivered into pocket 1. This is indicated by the selection of "ALL" in box C2,R1. No calls are presented in pocket 1 while suspects, improperly size bills and unfit document are presented in pocket 2. Chains and doubles are directed to pocket 1 and the machine stops.

Turning to FIG. 40, an example of the operating parameters selection screen for a third user defined mode is illustrated. According to the selections made in FIG. 40, bills of all denominations (as in a mixed mode) are delivered into pocket 2. No calls are presented in pocket 2 while suspects, improperly size bills and unfit document are presented in pocket 1. Chains and doubles are directed to pocket 1 and the machine stops.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and herein



described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

**WHAT IS CLAIMED IS...****Claims:**

1. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

5 a plurality of output receptacles for receiving said bills after said bills have been evaluated;

a transport mechanism for transporting said bills, one at a time, from said input receptacle to one of said output receptacles along a transport path;

a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacle, said  
10 discriminating unit counting and determining the denomination of said bills; and

means for flagging bills meeting or failing to meet a certain criteria; wherein said means for flagging causes said transport mechanism to halt in response to a determination that a bill meets or fails to meet said criteria, said bill meeting or failing to meet said criteria being termed a flagged bill.

2. The currency evaluation device of claim 1 wherein said means for flagging causes  
15 said transport mechanism to halt with said flagged bill being positioned at an identifiable location in one of said output receptacles.

3. The currency evaluation device of claim 1 wherein said means for flagging causes said transport mechanism to halt with said flagged bill being located at an identifiable location within said transport mechanism.

20 4. The currency evaluation device of claim 1 wherein said means for flagging causes said transport mechanism to halt with said flagged bill being located at a predetermined position.

5. The currency evaluation device of claim 1 wherein said certain criteria is said discriminating unit determining the denomination of a bill and wherein said means for flagging causes said transport mechanism to halt when a bill fails to meet said criteria of having its  
25 denomination determined by said discriminating unit, said bill failing to meet said criteria having its denomination determined by said discriminating unit being termed a no call bill.

6. The currency evaluation device of claim 5 wherein said means for flagging causes said transport mechanism to halt with said no call bill being positioned at an identifiable location in one of said output receptacles.

7. The currency evaluation device of claim 5 wherein said means for flagging a bill causes said transport mechanism to halt with said no call bill being located at a predetermined position.

8. The currency evaluation device of claim 5 wherein bills meeting said certain criteria of having their denomination determined by said discriminating unit are delivered to a first set of said output receptacles and wherein said no call bill is directed to a second set of output receptacles, said output receptacles of said second set being different from said output receptacles of said first set.

9. The currency evaluation device of claim 8 wherein said second set of output receptacles consists of a single no call output receptacle.

10. The currency evaluation device of claim 9 wherein said means for flagging causes said transport mechanism to halt before said no call bill has been delivered to said no call output receptacle.

11. The currency evaluation device of claim 9 wherein said means for flagging causes said transport mechanism to halt after said no call bill has been delivered to said no call output receptacle.

12. The currency evaluation device of claim 11 wherein said means for flagging causes said transport mechanism to halt with said no call bill being positioned at an identifiable location in said no call output receptacle.

13. The currency evaluation device of claim 12 wherein said means for flagging causes said transport mechanism to halt with said no call bill being the last bill transported to said no call output receptacle.

14. The currency evaluation device of claim 8 wherein said means for flagging causes said transport mechanism to halt before said no call bill has been delivered to one of said second set output receptacles.

5 15. The currency evaluation device of claim 14 wherein said flagging device causes said transport mechanism to halt with said no call bill being located at an identifiable location within said transport mechanism.

16. The currency evaluation device of claim 8 wherein said means for flagging causes said transport mechanism to halt after said no call bill has been delivered to one of said second set output receptacles.

10 17. The currency evaluation device of claim 16 wherein said means for flagging causes said transport mechanism to halt with said no call bill being positioned at an identifiable location in one of said second set output receptacles.

15 18. The currency evaluation device of claim 17 wherein said means for flagging causes said transport mechanism to halt with said no call bill being the last bill transported to one of said second set output receptacles.

20 19. The currency evaluation device of claim 1 wherein said discriminating unit further determines whether said bills are suspect and wherein said certain criteria is said discriminating unit determining a bill is suspect and wherein said means for flagging causes said transport mechanism to halt when a bill meets said criteria of being determined to be suspect by said discriminating unit, said bill being determined to be suspect being termed a suspect bill.

20. The currency evaluation device of claim 19 wherein bills whose denomination has been determined by said discriminating unit are delivered to a first set of said output receptacles and wherein said suspect bill is directed to a second set of output receptacles, said output receptacles of said second set being different from said output receptacles of said first set.

21. The currency evaluation device of claim 20 wherein said second set of output receptacles consists of a single suspect output receptacle.

22. The currency evaluation device of claim 21 wherein said means for flagging causes said transport mechanism to halt before said suspect bill has been delivered to said suspect output  
5 receptacle.

23. The currency evaluation device of claim 21 wherein said means for flagging causes said transport mechanism to halt after said suspect bill has been delivered to said suspect output receptacle.

24. The currency evaluation device of claim 23 wherein said means for flagging causes  
10 said transport mechanism to halt with said suspect bill being positioned at an identifiable location in said suspect output receptacle.

25. The currency evaluation device of claim 24 wherein said means for flagging causes said transport mechanism to halt with said suspect bill being the last bill transported to said suspect output receptacle.

26. The currency evaluation device of claim 20 wherein said flagging device causes said  
15 transport mechanism to halt before said suspect bill has been delivered to one of said second set output receptacles.

27. The currency evaluation device of claim 26 wherein said flagging device causes said transport mechanism to halt with said suspect bill being located at an identifiable location within  
20 said transport mechanism.

28. The currency evaluation device of claim 20 wherein said flagging device causes said transport mechanism to halt after said suspect bill has been delivered to one of said second set output receptacles.

29. The currency evaluation device of claim 28 wherein said means for flagging causes said transport mechanism to halt with said suspect bill being positioned at an identifiable location in one of said second set output receptacles.

30. The currency evaluation device of claim 29 wherein said means for flagging causes  
5 said transport mechanism to halt with said suspect bill being the last bill transported to one of said second set output receptacles.

31. The currency evaluation device of claim 1 wherein said certain criteria is said discriminating unit determining the denomination of said bill and wherein said means for flagging causes said transport mechanism to halt when a bill fails to meet said criteria of having its  
10 denomination determined by said discriminating unit, said bill failing to meet said criteria having its denomination determined by said discriminating unit being termed a no call bill, and  
wherein said discriminating unit further determines whether said bills are suspect.

32. The currency evaluation device of claim 31 wherein said means for flagging also causes said transport mechanism to halt when a bill meets a second criteria of being determined to  
15 be suspect by said discriminating unit.

33. The currency evaluation device of claim 32 wherein bills whose denomination has been determined by said discriminating unit are delivered to a first set of said output receptacles and wherein bills determined by said discriminating unit to be suspect and bills whose denomination has not been determined by said discriminating unit are delivered to a second set of said output  
20 receptacles, said output receptacles of said second set being different from said output receptacles of said first set.

34. The currency evaluation device of claim 33 wherein said flagging device causes said transport mechanism to halt after a no call bill or a suspect bill has been delivered to an output receptacle of said second set.

35. The currency evaluation device of claim 34 wherein said means for flagging causes said transport mechanism to halt with said no call bill or said suspect bill being the last bill transported to an output receptacle of said second set.

36. The currency evaluation device of claim 33 wherein bills determined by said  
5 discriminating unit to be suspect and bills whose denomination has not been determined by said discriminating unit are delivered to different output receptacles.

37. The currency evaluation device of claim 33 wherein said second set of said output receptacles consists of a single output receptacle.

38. The currency evaluation device of claim 31 wherein bills whose denomination has  
10 been determined by said discriminating unit are delivered to a first set of said output receptacles and wherein bills whose denomination has not been determined by said discriminating unit are delivered to a second set of said output receptacles, said output receptacles of said second set being different from said output receptacles of said first set.

39. The currency evaluation device of claim 38 wherein said flagging device causes said  
15 transport mechanism to halt after a no call bill has been delivered to an output receptacle of said second set.

40. The currency evaluation device of claim 38 wherein bills determined by said discriminating unit to be suspect by said discriminating unit are also delivered to said second set of said output receptacles.

41. The currency evaluation device of claim 40 wherein said flagging device causes said  
20 transport mechanism to halt after a no call bill or a suspect bill has been delivered to an output receptacle of said second set.

42. The currency evaluation device of claim 40 wherein bills determined by said discriminating unit to be suspect and bills whose denomination has not been determined by said  
25 discriminating unit are delivered to different output receptacles.

43. The currency evaluation device of claim 1 having exactly two output receptacles.

44. The currency evaluation device of claim 43 wherein said means for flagging causes said transport mechanism to halt with said flagged bill being positioned at an identifiable location in one of said output receptacles.

5 45. The currency evaluation device of claim 43 wherein said means for flagging causes said transport mechanism to halt with said flagged bill being located at an identifiable location within said transport mechanism.

46. The currency evaluation device of claim 43 wherein said means for flagging causes said transport mechanism to halt with said flagged bill being located at a predetermined position.

10 47. The currency evaluation device of claim 43 wherein said certain criteria is said discriminating unit determining the denomination of a bill and wherein said means for flagging causes said transport mechanism to halt when a bill fails to meet said criteria of having its denomination determined by said discriminating unit, said bill failing to meet said criteria having its denomination determined by said discriminating unit being termed a no call bill.

15 48. The currency evaluation device of claim 47 wherein said means for flagging causes said transport mechanism to halt with said no call bill being positioned at an identifiable location in one of said output receptacles.

20 49. The currency evaluation device of claim 47 wherein said means for flagging a bill causes said transport mechanism to halt with said no call bill being located at a predetermined position.

50. The currency evaluation device of claim 47 wherein bills meeting said certain criteria of having their denomination determined by said discriminating unit are delivered to a first output receptacle and wherein said no call bill is directed to the other output receptacle.



51. The currency evaluation device of claim 50 wherein said means for flagging causes said transport mechanism to halt before said no call bill has been delivered to said other output receptacle.

5 52. The currency evaluation device of claim 50 wherein said means for flagging causes said transport mechanism to halt after said no call bill has been delivered to said other output receptacle.

53. The currency evaluation device of claim 52 wherein said means for flagging causes said transport mechanism to halt with said no call bill being positioned at an identifiable location in said other output receptacle.

10 54. The currency evaluation device of claim 53 wherein said means for flagging causes said transport mechanism to halt with said no call bill being the last bill transported to said other output receptacle.

15 55. The currency evaluation device of claim 43 wherein said discriminating unit further determines whether said bills are suspect and wherein said certain criteria is said discriminating unit determining a bill is suspect and wherein said means for flagging causes said transport mechanism to halt when a bill meets said criteria of being determined to be suspect by said discriminating unit, said bill being determined to be suspect being termed a suspect bill.

20 56. The currency evaluation device of claim 55 wherein bills whose denomination has been determined by said discriminating unit are delivered to a first output receptacle and wherein said suspect bill is directed to the other output receptacle.

57. The currency evaluation device of claim 56 wherein said means for flagging causes said transport mechanism to halt after said suspect bill has been delivered to said other output receptacle.

58. The currency evaluation device of claim 57 wherein said means for flagging causes said transport mechanism to halt with said suspect bill being positioned at an identifiable location in said other output receptacle.

5 59. The currency evaluation device of claim 58 wherein said means for flagging causes said transport mechanism to halt with said suspect bill being the last bill transported to said other output receptacle.

60. The currency evaluation device of claim 56 wherein bills whose denomination has not been determined by said discriminating unit are also delivered to said other output receptacle.

10 61. The currency evaluation device of claim 50 wherein said transport mechanism is not halted in response to the denomination of a bill not being determined.

62. The currency evaluation device of claim 56 wherein bills whose denomination has not been determined by said discriminating unit are directed to said first output receptacle.

15 63. The currency evaluation device of claim 43 wherein said certain criteria is said discriminating unit determining the denomination of said bill and wherein said means for flagging causes said transport mechanism to halt when a bill fails to meet said criteria of having its denomination determined by said discriminating unit, said bill failing to meet said criteria having its denomination determined by said discriminating unit being termed a no call bill, and wherein said discriminating unit further determines whether said bills are suspect.

20 64. The currency evaluation device of claim 63 wherein said means for flagging also causes said transport mechanism to halt when a bill meets a second criteria of being determined to be suspect by said discriminating unit.

25 65. The currency evaluation device of claim 64 wherein bills whose denomination has been determined by said discriminating unit are delivered to a first output receptacle and wherein bills determined by said discriminating unit to be suspect and bills whose denomination has not been determined by said discriminating unit are directed to the other output receptacle.

66. The currency evaluation device of claim 65 wherein said flagging device causes said transport mechanism to halt after a no call bill or a suspect bill has been delivered to said other output receptacle.

67. The currency evaluation device of claim 66 wherein said means for flagging causes said transport mechanism to halt with said no call bill or said suspect bill being the last bill transported to said other output receptacle.

68. The currency evaluation device of claim 63 wherein bills whose denomination has been determined by said discriminating unit are delivered to a first output receptacle and wherein bills whose denomination has not been determined by said discriminating unit are directed to the other output receptacle.

69. The currency evaluation device of claim 68 wherein bills determined by said discriminating unit to be suspect are also delivered to said other output receptacle.

70. The currency evaluation device of claim 68 wherein bills determined by said discriminating unit to be suspect are delivered to said first output receptacle.

71. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;  
a plurality of output receptacles for receiving said bills after said bills have been evaluated;  
a transport mechanism for transporting said bills, one at a time, from said input receptacle to one of said output receptacles along a transport path;

a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacles, said discriminating unit counting and determining the denomination of said bills; and

means for flagging a bill when the denomination of said bill is not determined by said discriminating unit, wherein said means for flagging causes said transport mechanism to halt.

72. The currency evaluation device of claim 71 wherein said means for flagging causes said transport mechanism to halt with said bill whose denomination has not been determined being the last bill transported to said output receptacle.

73. The currency evaluation device of claim 71 wherein said means for flagging a bill causes said transport mechanism to halt with said bill whose denomination has not been determined being located at a predetermined position.

74. The currency evaluation device of claim 71 wherein said detector of said discriminating unit includes a stationary optical scanning head for scanning at least a preselected segment of each bill transported between said input and output receptacles by said transport mechanism, and producing an output signal representing the scanned image and wherein said discriminating unit includes signal processing means for receiving said output signal and determining the denomination of each scanned bill.

75. The currency evaluation device of claim 71 wherein said transport mechanism transports bills at a rate of at least about 800 bills per minute.

76. The currency evaluation device of claim 71 wherein said transport mechanism transports bills at a rate of at least about 1000 bills per minute.

77. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

a plurality of output receptacles for receiving said bills after said bills have been evaluated;

a transport mechanism for transporting said bills, one at a time, from said input receptacle to one of said output receptacles along a transport path;

a discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacle, said discriminating unit counting and determining the denomination of said bills and determining whether said bills are counterfeit; and

means for flagging a bill when said bill is determined to be counterfeit by said discriminating unit; wherein said means for flagging causes said transport mechanism to halt when said discriminating unit determines that a bill is counterfeit.

78. The currency evaluation device of claim 77 wherein said means for flagging  
5 causes said transport mechanism to halt with said bill which is determined to be counterfeit being the last bill transported to one of said output receptacles.

79. The currency evaluation device of claim 77 wherein said means for flagging a bill causes said transport mechanism to halt with said bill which is determined to be counterfeit being located at a predetermined position.

10 80. The currency evaluation device of claim 77 wherein said detector of said discriminating unit includes a stationary optical scanning head for scanning at least a preselected segment of each bill transported between said input and output receptacles by said transport mechanism, and producing an output signal representing the scanned image and wherein said discriminating unit includes signal processing means for receiving said output  
15 signal and determining the denomination of each scanned bill.

81. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

20 a plurality of output receptacles positioned to receive said bills after said bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, said transport mechanism located between said input receptacle and said output receptacle to transport said bills, one at a time, from said input receptacle to one of said output receptacles along a transport path;

25 a discriminating unit comprising a detector positioned along said transport path between said input receptacle and said output receptacle and comprising a central processing unit, said detector generating a characteristic information output signal in response to detected characteristic information, said characteristic information output signal being electrically

coupled to said central processing unit, said central processing unit receiving said characteristic information output signal and generating a denomination signal in response thereto; and

a flagging device comprising said central processing unit and an encoder linked to said transport mechanism, said encoder producing tracking signals in response to the physical movement of said bills, said central processing unit generating a no call signal when the denomination of a bill is not determined by said central processing unit; wherein said flagging device generates a stopping signal in response to said no call signal and wherein said transport drive motor stops in response to said stopping signal.

82. The currency evaluation device of claim 81 wherein said central processing unit generates a scanned pattern from each of said bills based on said characteristic information output signal and determines the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, said master patterns being stored in a memory.

83. The currency evaluation device of claim 82 wherein said detector comprises an optical scanhead and wherein said scanned and master patterns comprise optical patterns.

84. The currency evaluation device of claim 83 wherein said central processing unit correlates the scanned pattern generated from the bill with master patterns associated with different denominations of bills and determines the denomination of the bill if the scanned pattern sufficiently correlates with one of the master patterns.

85. The currency evaluation device of claim 81 wherein said flagging device causes said transport mechanism to halt with said bill whose denomination has not been determined being located at a predetermined position.

86. The currency evaluation device of claim 81 wherein said flagging device causes said transport mechanism to halt with said bill whose denomination has not been determined being the last bill transported to one of said output receptacles.

87. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

a plurality of output receptacles positioned to receive said bills after said bills have  
5 been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, said transport mechanism located between said input receptacle and said output receptacle to transport said bills, one at a time, from said input receptacle to one of said output receptacles along a transport path;

10 a discriminating unit comprising a detector positioned along said transport path between said input receptacle and said output receptacle and comprising a central processing unit, said detector generating a characteristic information output signal in response to detected characteristic information, said characteristic information output signal being electrically coupled to said central processing unit, said central processing unit receiving said  
15 characteristic information output signal and generating a denomination signal in response thereto; said central processing unit also generating a counterfeit signal when a bill is determined to be counterfeit by said central processing unit, and

a flagging device comprising said central processing unit and an encoder linked to said transport mechanism, said encoder producing tracking signals in response to the physical  
20 movement of said bills; wherein said flagging device generates a stopping signal in response to said counterfeit signal and wherein said transport drive motor stops in response to said stopping signal.

88. A method of counting and discriminating currency bills of different denominations using a currency evaluation device comprising the steps of:

25 receiving a stack of bills to be evaluated an input receptacle of the evaluation device;

transporting, under control of the evaluation device, said bills, one at a time, from said input receptacle to one of a plurality of output receptacles of the evaluation device;

counting and determining the denomination of said bills under control of the evaluation device; and

30 performing a currency authentication test on said bills under control of the evaluation device; and

flagging, under control of the evaluation device, a bill meeting or failing to meet a certain criteria; wherein said flagging step comprises halting said transporting of said bills in said stack.

5        89.     The method of claim 88 wherein said certain criteria is the evaluation device determining the denomination of said bill and wherein said flagging step comprises halting said transporting of said bills in said stack when said bill fails to meet said criteria of having its denomination determined by said evaluation device.

90.     The method of claim 89 wherein said flagging step comprises halting said transporting of said bills in said stack with said bill being located at a predetermined position.

10       91.     The method of claim 89 wherein said flagging step comprises halting said transporting of said bills in said stack with said bill being the last bill transported to one of said output receptacles.

15       92.     The method of claim 88 wherein said certain criteria is the evaluation device determining said bill is counterfeit and wherein said flagging step comprises halting said transporting of said bills in said stack when said bill fails said currency authentication test.

93.     The method of claim 92 wherein said flagging step comprises halting said transporting of said bills in said stack with said bill being located at a predetermined position.

20       94.     The method of claim 92 wherein said flagging step comprises halting said transporting of said bills in said stack with said bill being the last bill transported to one of said output receptacles.

95.     The method of claim 88 wherein said flagging step comprises halting said transporting of said bills in said stack with said bill being located at a predetermined position.



96. The method of claim 88 wherein said flagging step comprises halting said transporting of said bills in said stack with said bill being the last bill transported to one of said output receptacles.

5 97. The method of claim 88 wherein said step of determining the denomination of said bills comprises scanning by a stationary optical scanning head at least a preselected segment of each bill transported between said input and output receptacles, and producing an output signal representing the scanned image.

98. A method of operating a currency evaluation device that discriminates the denomination currency bills comprising the steps of:  
10 receiving a stack of bills to be evaluated an input receptacle of the evaluation device;  
transporting, under control of the evaluation device, said bills, one at a time, from said input receptacle to a plurality of output receptacles of the evaluation device;  
determining the denomination of said bills under control of the evaluation device; and  
presenting in one of said output receptacles bills whose denominations are not  
15 determined by said determining step.

99. The method of claim 98 wherein bills whose denominations are determined are transported to a first set of output receptacles and wherein bills whose denominations are not determined are delivered to a second set of output receptacles, wherein said output receptacles of said second set are different from said output receptacles of said first set.

20 100. The method of claim 98 wherein said evaluation device consists of two output receptacles and wherein bills whose denominations are determined are transported to a first output receptacle and wherein bills whose denominations are not determined are presented in the other output receptacle.

101. The method of claim 98 further comprising the step of performing a currency  
25 authentication test on said bills under control of the evaluation device.

102. The method of claim 101 wherein bills whose denominations are determined are transported to a first set of output receptacles and wherein bills whose denominations are not determined are delivered to a second set of output receptacles, wherein said output receptacles of said second set are different from said output receptacles of said first set.

5           103. The method of claim 102 wherein bills that fail said authentication test are presented in one of said first set output receptacles.

104. The method of claim 103 wherein bills that fail said authentication test are presented in one of said second set output receptacles.

10           105. The method of claim 101 wherein said evaluation device consists of two output receptacles and wherein bills whose denominations are determined are transported to a first output receptacle and wherein bills whose denominations are not determined are presented in the other output receptacle.

106. The method of claim 105 wherein bills that fail said authentication test are presented in said first output receptacle.

15           107. The method of claim 105 wherein bills that fail said authentication test are presented in said other output receptacle.

108. A method of operating a currency evaluation device that discriminates the denomination currency bills and authenticates the currency bills comprising the steps of:  
receiving a stack of bills to be evaluated an input receptacle of the evaluation device;  
20           transporting, under control of the evaluation device, said bills, one at a time, from said input receptacle to a plurality of output receptacles of the evaluation device;  
determining the denomination of said bills under control of the evaluation device;  
performing a currency authentication test on said bills under control of the evaluation device; and  
25           presenting in one of said output receptacles bills that fail said authentication test.

109. The method of claim 108 wherein bills whose denominations are determined are transported to a first set of output receptacles and wherein bills that fail said authentication test are delivered to a second set of output receptacles, wherein said output receptacles of said second set are different from said output receptacles of said first set.

5        110. The method of claim 109 wherein bills whose denominations are not determined are presented in one of said first set output receptacles.

111. The method of claim 109 wherein bills whose denominations are not determined are presented in one of said second set output receptacles.

10        112. The method of claim 109 wherein bills whose denominations are not determined are off-sorted to one of said second set output receptacles without halting said transporting step.

15        113. The method of claim 108 wherein said evaluation device consists of two output receptacles and wherein bills whose denominations are determined are transported to a first output receptacle and wherein bills that fail said authentication test are presented in the other output receptacle.

114. The method of claim 113 wherein bills whose denominations are not determined are presented in said first output receptacle.

115. The method of claim 113 wherein bills whose denominations are not determined are presented in said other output receptacle.

20        116. The method of claim 113 wherein bills whose denominations are not determined are off-sorted to said other output receptacle without halting said transporting step.

117. A method of operating a currency evaluation device that discriminates the denomination currency bills and authenticates the currency bills comprising the steps of:

receiving a stack of bills to be evaluated an input receptacle of the evaluation device;  
transporting, under control of the evaluation device, said bills, one at a time, from said  
input receptacle to a plurality of output receptacles of the evaluation device;  
determining the denomination of said bills under control of the evaluation device;  
5 performing a currency authentication test on said bills under control of the evaluation  
device;  
detecting any bills transported in a doubled or overlapping manner; and  
presenting in one of said output receptacles bills meeting or failing to meet certain  
criteria.

10 118. The method of claim 117 wherein bills whose denominations are determined  
are transported to a first set of output receptacles and wherein bills that fail said authentication  
test and bills that are detected being transported in a doubled or overlapping manner are  
delivered to a second set of output receptacles, wherein said output receptacles of said second  
set are different from said output receptacles of said first set.

15 119. The method of claim 118 wherein bills whose denominations are not  
determined are presented in one of said first set output receptacles.

120. The method of claim 117 wherein bills whose denominations are not  
determined are presented in a first set of output receptacles and bills that are detected being  
transported in a doubled or overlapping manner are delivered to said first set of output  
20 receptacles and wherein bills that fail said authentication test are presented in a second set of  
output receptacles, wherein said output receptacles of said second set are different from said  
output receptacles of said first set.

121. The method of claim 117 wherein the evaluation device consists of two output  
receptacles and wherein bills whose denominations are not determined are presented in a first  
25 output receptacle, bills that are detected being transported in a doubled or overlapping manner  
are delivered to said first output receptacle, and bills that fail said authentication test are  
presented in the other output receptacle.

122. The method of claim 117 wherein the evaluation device consists of two output receptacles and wherein bills whose denominations are determined are delivered to a first output receptacle, bills whose denominations are not determined are presented in said first output receptacle, bills that are detected being transported in a doubled or overlapping manner are delivered to the other output receptacle, and bills that fail said authentication test are presented in said other output receptacle.

123. A method of operating a currency evaluation device that discriminates the denomination currency bills comprising the steps of:

receiving a stack of bills to be evaluated an input receptacle of the evaluation device;  
transporting, under control of the evaluation device, said bills, one at a time, from said input receptacle to one or more output receptacles of the evaluation device;  
determining the denomination of said bills under control of the evaluation device;  
detecting the occurrence of an error condition; and  
suspending said transporting upon the detection of said error condition so that a bill triggering said error condition is stopped before being delivered into one of said output receptacles such that said bill is located within said transport mechanism.

124. The currency evaluation device of claim 123 wherein said bill is stopped at a predetermined position with said transport mechanism.

125. The currency evaluation device of claim 123 wherein said error condition is a stranger error condition.

126. The currency evaluation device of claim 123 wherein said error condition is a denomination change error condition.

127. The currency evaluation device of claim 123 wherein said error condition is a separate series error condition.

128. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

5 a plurality of output receptacles for receiving said bills after said bills have been evaluated;

a transport mechanism for transporting said bills, one at a time, from said input receptacle to said output receptacles along a transport path;

10 a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacles, said discriminating unit counting and determining the denomination of said bills;

means for flagging a bill meeting or failing to meet a certain criteria, said means for flagging causing said transport mechanism to halt in response to the detection of a bill meeting or failing to meet said criteria; and

15 a routing interface, said routing interface comprising a data retrieval device, said data retrieval device receiving information from a user of said evaluation device specifying to which output receptacles bills that are flagged by said flagging means bills are to be directed.

129. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

20 a plurality of output receptacles for receiving said bills after said bills have been evaluated;

a transport mechanism for transporting said bills, one at a time, from said input receptacle to said output receptacles along a transport path;

25 a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacles, said discriminating unit determining the denomination of said bills; and

30 a routing interface comprising a data retrieval device, said data retrieval device receiving information from a user of said evaluation device specifying to which output receptacles bills of one or more denominations and bills whose denominations have not been determined by said discriminating unit are to be directed; said routing interface permitting said

user to direct bills whose denominations have not been determined to any one or any group of said plurality of output receptacles.

130. The currency evaluation device of claim 129 further comprising a flagging control interface, said flagging control interface comprising a flagging data retrieval device, said flagging data retrieval device receiving information from a user of said evaluation device specifying whether said evaluation device should suspend operation based on the detection of a bill whose denomination has not been determined.

131. The currency evaluation device of claim 130 wherein said flagging data retrieval device receives information from said user specifying a predetermined position at which said bill whose denomination has not been determined is to be located when the operation of said evaluation device is suspended.

132. The currency evaluation device of claim 131 wherein said flagging data retrieval device permits said user to specify that a bill whose denomination has not been determined is to be the last bill delivered to one of said output receptacles when the operation of said evaluation device is suspended.

133. The currency evaluation device of claim 130 wherein said flagging data retrieval device comprises a touch-screen.

134. The currency evaluation device of claim 129 wherein said data retrieval device comprises a touch-screen.

135. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

a plurality of output receptacles for receiving said bills after said bills have been evaluated;

a transport mechanism for transporting said bills, one at a time, from said input receptacle to said output receptacles along a transport path;

a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacles, said discriminating unit determining the denomination of said bills;

means for flagging a bill meeting or failing to meet a certain criteria; and

a routing interface comprising a data retrieval device, said data retrieval device receiving information from a user of said evaluation device specifying to which output receptacles bills flagged by said means for flagging are to be directed; said routing interface permitting said user to direct flagged bills to any one or any group of said plurality of output receptacles.

136. The currency evaluation device of claim 135 further comprising a flagging control interface, said flagging control interface comprising a flagging data retrieval device, said flagging data retrieval device receiving information from a user of said evaluation device specifying whether said evaluation device should suspend operation based on the detection of a bill meeting or failing to meet said criteria.

137. The currency evaluation device of claim 136 wherein said flagging data retrieval device receives information from said user specifying a predetermined position at which said flagged bill is to be located when the operation of said evaluation device is suspended.

138. The currency evaluation device of claim 137 wherein said flagging data retrieval device permits said user to specify that a flagged bill is to be the last bill delivered to one of said output receptacles when the operation of said evaluation device is suspended.

139. The currency evaluation device of claim 137 wherein said flagging data retrieval device permits said user to specify that the operation of said evaluation device is to be suspended before a flagged bill has been delivered to one of said output receptacles.



140. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

5 a plurality of output receptacles for receiving said bills after said bills have been evaluated;

a transport mechanism for transporting said bills, one at a time, from said input receptacle to said output receptacles along a transport path;

10 a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacles, said discriminating unit determining the denomination of said bills and detecting the occurrence of a plurality of error conditions;

an interface permitting a user of said evaluation device to specify how said plurality of error conditions are to be handled.

141. The currency evaluation device of claim 140 wherein said interface permits said user to specify, for each of said error conditions, to which output receptacle or receptacles a bill triggering a particular error condition is to be directed.

142. The currency evaluation device of claim 140 wherein said interface permits said user to specify, for each of said error conditions, whether said evaluation device should suspend operation.

20 143. The currency evaluation device of claim 140 wherein said interface permits said user to specify that the operation of said evaluation device should be suspended so that a bill triggering a particular error condition is stopped before being delivered into one of said output receptacles such that said bill is located within said transport mechanism.

25 144. The currency evaluation device of claim 143 wherein said bill is stopped at a predetermined position within said transport mechanism.

145. The currency evaluation device of claim 143 wherein said particular error condition is a stranger error condition.

146. The currency evaluation device of claim 143 wherein said particular error condition is a denomination change error condition.

5 147. The currency evaluation device of claim 143 wherein said particular error condition is a separate series error condition.

148. The currency evaluation device of claim 140 wherein said interface permits said user to specify that upon the occurrence of a particular error condition (1) the operation of said evaluation device should be suspended or (2) a bill triggering said particular error  
10 condition should be off-sorted to an output receptacle without suspending the operation of said evaluation device.

149. The currency evaluation device of claim 148 wherein said interface permits said user to specify that upon the occurrence of a particular error condition the operation of said evaluation device should be suspended so that a bill triggering said particular error condition is  
15 presented in an output receptacle.

150. The currency evaluation device of claim 148 wherein said interface permits said user to specify that upon the occurrence of a particular error condition the operation of said evaluation device should be suspended so that a bill triggering a particular error condition is stopped before being delivered into one of said output receptacles such that said bill is located  
20 within said transport mechanism.

151. The currency evaluation device of claim 140 wherein said interface permits said user to specify that upon the occurrence of a particular error condition whether the operation of said evaluation device should be suspended so that a bill triggering a particular error condition is stopped (1) before being delivered into one of said output receptacles such that  
25 said bill is located within said transport mechanism or (2) after being delivered into one of said output receptacles such that said bill is the last bill delivered into said one output receptacle.

152. The currency evaluation device of claim 151 wherein said particular error condition is a stranger error condition.

153. The currency evaluation device of claim 151 wherein said particular error condition is a denomination change error condition.

5           154. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

at least one output receptacle for receiving said bills after said bills have been evaluated;

10           a transport mechanism for transporting said bills, one at a time, from said input receptacle to said output receptacles along a transport path;

a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacles, said discriminating unit determining the denomination of said bills and detecting  
15 the occurrence of a plurality of error conditions;

wherein upon the detection of a particular error condition the operation of said evaluation device is suspended so that a bill triggering said particular error condition is stopped before being delivered into said output receptacle such that said bill is located within said transport mechanism.

20           155. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

at least one output receptacle for receiving said bills after said bills have been evaluated;

25           a transport mechanism for transporting said bills, one at a time, from said input receptacle to said output receptacles along a transport path;

a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output

receptacles, said discriminating unit determining the denomination of said bills and detecting the occurrence of a plurality of error conditions; and

an interface permitting a user to specify that the operation of said evaluation device should be suspended upon the detection of a particular error condition so that a bill triggering said particular error condition is stopped before being delivered into one of said output receptacles such that said bill is located within said transport mechanism.

156. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

a plurality of output receptacles for receiving said bills after said bills have been evaluated;

a transport mechanism for transporting said bills, one at a time, from said input receptacle to said output receptacles along a transport path;

a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacles, said discriminating unit determining the denomination of said bills, said discriminating unit further determining whether any of said bills are suspect;

a routing interface comprising a data retrieval device, said data retrieval device receiving information from a user of said evaluation device specifying to which output receptacles (1) bills of one or more denominations, (2) bills whose denominations have not been determined by said discriminating unit, and (3) bills that are determined to be suspect are to be directed; said routing interface permitting said user to direct bills whose denominations have not been determined and bills that are determined to be suspect to any one or any group of said plurality of output receptacles.

157. A currency evaluation device comprising:

a discriminating unit for evaluating currency bills, said discriminating unit including a detector, said discriminating unit determining the denomination of said bills and detecting the occurrence of a plurality of error conditions;

an interface permitting a user of said evaluation device to specify how said plurality of error conditions are to be handled; and

a memory storing user information specifying how said plurality of error conditions are to be handled.

5           158. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

an output receptacle for receiving said bills after said bills have been evaluated;

10          a transport mechanism for transporting said bills, one at a time, from said input receptacle to said output receptacle along a transport path;

a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacle, said discriminating unit determining the denomination of said bills and detecting the occurrence of a plurality of error conditions;

15          a memory storing information associated with a plurality of modes of operation of the device, said memory being designed to store at least one user-defined mode of operation;

an interface permitting a user of said evaluation device to define said user-defined mode of operation; said interface receiving information from said user specifying how said device is to operate including how said plurality of error conditions are to be handled; said  
20 information being stored in said memory;

a mode selection element permitting the user to select one of said modes of operation.

159. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

25          a plurality of output receptacles for receiving said bills after said bills have been evaluated;

a transport mechanism for transporting said bills, one at a time, from said input receptacle to said output receptacle along a transport path;

a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacles, said discriminating unit determining the denomination of said bills and detecting the occurrence of a plurality of error conditions;

5 a nonvolatile memory storing information associated with a plurality of modes of operation of the device, said memory being designed to store at least one user-defined mode of operation;

an interface permitting a user of said evaluation device to define said user-defined mode of operation; said interface receiving information from said user specifying criteria for  
10 evaluating said bills and specifying to which output receptacle a bill meeting a certain criteria is to be directed; said information being stored in said nonvolatile memory; and

a mode selection element permitting the user to select one of said modes of operation.

160. A currency transport mechanism for transporting currency bills, one at a time, to one of a plurality of output receptacles, said currency transport mechanism comprising:

15 at least one transport plate being substantially smooth and without surface features and having therein a plurality of apertures;

at least one follower plate being substantially smooth and without surface features, said at least one follower plate being substantially parallel and positioned in spaced relation to said at least one transport plate so as to define a currency pathway there between; and

20 a plurality of transport rolls wherein each transport roll protrudes through a corresponding one of said plurality of apertures so as to frictionally engage and transport currency bills along said pathway.

161. A transport mechanism for transporting documents, one at a time, to one of a plurality of output receptacles, said transport mechanism comprising:

25 at least one transport plate being substantially smooth and without surface features and having therein a plurality of apertures; and

at least one follower plate being substantially smooth and without surface features, said at least one follower plate being substantially parallel and positioned in spaced relation to said at least one transport plate so as to define a pathway there between, said at least one follower

plate being adapted to be moved apart from said at least one transport plate so as to allow access to said pathway, said at least one follower plate includes at least one diverter having an open and a closed position being triggered by at least one solenoid, said closed position being defined by documents being diverted from said pathway into one of said plurality of output receptacles, and said open position being defined by documents progressing along said pathway past said at least one diverter.

162. A transport mechanism for carrying currency bills, one at a time, to an evaluating mechanism and then to one of a plurality of output receptacles, said transport mechanism comprising:

transport means for carrying currency bills between an evaluating mechanism and a plurality of output receptacles, said transport means having a first substantially planar region defining a first plane and a second substantially planar region defining a second plane, said first substantially planar region and said second substantially planar region substantially defining said transport means between said evaluating mechanism and said plurality of output receptacles, and said second substantially planar region does not deviate substantially from said first substantially planar region.

163. A transport mechanism for carrying documents, one at a time, to an discriminating and authenticating mechanism having at least one scanhead and then to one of a plurality of output receptacles, said transport mechanism comprising:

transport means having at least one transport plate having therein a plurality of apertures for carrying documents between a discriminating and authenticating mechanism and a plurality of output receptacles, said transport means having a first substantially planar region defining a first plane and a second substantially planar region defining a second plane, said first substantially planar region and said second substantially planar region substantially defining said transport means between said discriminating and authenticating mechanism and said plurality of output receptacles, said second substantially planar region does not deviate substantially from said first substantially planar region;

at least one follower plate being substantially smooth and without surface features, said at least one follower plate being substantially parallel and proximate to said at least one

transport plate, wherein said at least one follower plate and said at least one transport plate define a pathway there between; and

a plurality of transport rolls protruding through one of said plurality of apertures so as to frictionally engage and transport a document along said pathway towards one of said

5 plurality of output receptacles.



## **ABSTRACT..**

A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack. The device comprises an input receptacle for receiving a stack of bills to be evaluated and a plurality of output receptacles for receiving the bills after they have been evaluated. A transport mechanism transports the bills, one at a time, from the input receptacle to one of the output receptacles along a transport path. A discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacle evaluates the bills. The discriminating unit counts and determines the denomination of the bills. A means for flagging bills meeting or failing to meet a certain criteria causes the transport mechanism to halt in response to a determination that a bill meets or fails to meet the criteria.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re United States Continuation Application )  
Serial No. 10/027,449 ) Group Art Unit: 3652  
Applicant(s): Richard A. Mazur et al. ) Examiner: Mark J. Beauchaine  
Filing Date: December 21, 2001 ) Attorney Docket No.: 47171-00262USC2  
For: Method and Apparatus for Document )  
Processing )

**SECOND PRELIMINARY AMENDMENT**

Commissioner for Patents  
Washington, D.C. 20231  
Attention: Box Amendment-No Fee

**CERTIFICATE OF MAILING**

I hereby certify that this paper or fee is being deposited with the United States Postal Service on the date indicated below and is addressed to: Commissioner for Patents, Washington, D.C. 20231, Attention: Box Amendment-No Fee.

2/8/2002

Adrienne White

Sir:

Prior to examining the subject application, please enter the following amendment to the application as originally filed.

**IN THE CLAIMS:**

Please cancel claim 1 without prejudice.

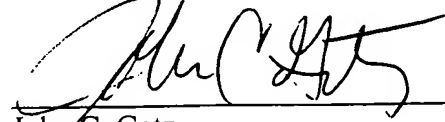
**Conclusion**

The Applicants believe that the remaining claims (claims 164-261) are in condition for allowance.

If there are any matters which may be resolved or clarified through a telephone interview, the Examiner is respectfully requested to contact the Applicants' undersigned attorney at the number indicated. Applicants believe that there are no fees associated with this Amendment.

However, the Commissioner is hereby authorized to charge deposit Account No. 10-0447 (47171-00262USC2) for any fees inadvertently omitted which may be necessary now or during the pendency of this application, except for the issue fee.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "John C. Gatz", written over a horizontal line.

Date: February 8, 2002

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**Pending Claims After Entry of  
Preliminary Amendment Mailed February 8, 2002**

164. A compact, high-speed United States currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of United States currency bills of a plurality of denominations to be evaluated;

two or more output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the output receptacles at a rate of at least 800 bills per minute;

a discriminating unit adapted to count and denominate the bills including United States bills of a plurality of denominations at a rate of at least 800 bills per minute, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles; and

a processor programmed to flag bills meeting or failing to meet any of certain non-piece count related criteria, a bill meeting or failing to meet any of the criteria being termed a flagged bill, the processor being adapted to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet at least one of the criteria.

165. The currency evaluation device of claim 164 wherein the device is adapted to deliver and at least one output receptacle is adapted to receive denominated bills of more than one denomination.

166. The currency evaluation device of claim 164 wherein the device is adapted to deliver and only one output receptacle is adapted to receive denominated bills of more than one denomination.

167. The currency evaluation device of claim 164 wherein the processor is adapted to cause the transport mechanism to halt with a bill satisfying the at least one criterion being positioned as the last bill in one of the output receptacles.

168. The currency evaluation device of claim 164 wherein the certain criteria include a criterion of the discriminating unit determining the denomination of a bill, a bill failing to meet the criterion of having its denomination determined by the discriminating unit being termed a no call bill, the processor being programmed to flag no call bills.

169. The currency evaluation device of claim 168 wherein the discriminating unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the certain criteria include the discriminating unit determining a bill is a stranger bill and wherein the processor is programmed to flag stranger bills.

170. The currency evaluation device of claim 169 wherein the discriminating unit is further adapted to determine whether a bill is a suspect bill and wherein the certain criteria include the discriminating unit determining a bill is a suspect bill and wherein the processor is programmed to flag suspect bills.

171. The currency evaluation device of claim 170 wherein stranger bills and no call bills are directed to a first set of one or more output receptacles and suspect bills are directed to a second set of one or more output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

172. The currency evaluation device of claim 171 wherein the first set of output receptacles includes at least two output receptacles.

173. The currency evaluation device of claim 171 wherein the processor is adapted to cause the transport mechanism to halt when a no call bill or a stranger bill is delivered to an output receptacle of the first set.

174. The currency evaluation device of claim 171 wherein the processor is adapted to cause the transport mechanism not to halt when a no call bill or a stranger bill is delivered to an output receptacle of the first set.

175. The currency evaluation device of claim 164 wherein the discriminating unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the certain criteria include the discriminating unit determining a bill to be a stranger bill, and wherein the processor is programmed to flag stranger bills.

176. The currency evaluation device of claim 164 wherein the discriminating unit is further adapted to determine whether a bill is suspect and wherein the certain criteria include the discriminating unit determining whether a bill is suspect, a bill determined to be suspect being termed a suspect bill and wherein the processor is programmed to flag suspect bills.

177. The currency evaluation device of claim 164 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

178. The currency evaluation device of claim 164 wherein the processor is adapted to cause the transport mechanism to halt with a bill meeting or failing to meet the at least one criterion being positioned at an identifiable location in one of the output receptacles.

179. The currency evaluation device of claim 164 wherein the processor is adapted to cause the transport mechanism to halt with a bill meeting or failing to meet the at least one criterion being located at an identifiable location within the transport mechanism.

180. The currency evaluation device of claim 164 wherein the processor is adapted to cause the transport mechanism to halt with a bill meeting or failing to meet the at least one criterion being located at a predetermined position.

181. The currency evaluation device of claim 164 wherein the certain criteria include the discriminating unit determining the denomination of a bill and wherein the processor is adapted to cause the transport mechanism to halt when a bill fails to meet a criterion of having its

denomination determined by the discriminating unit, a bill failing to meet the criterion of having its denomination determined by the discriminating unit being termed a no call bill.

182. The currency evaluation device of claim 181 wherein the processor is adapted to cause the transport mechanism to halt with a no call bill being positioned at an identifiable location in one of the output receptacles.

183. The currency evaluation device of claim 181 wherein the processor is adapted to cause the transport mechanism to halt with a no call bill being located at a predetermined position.

184. The currency evaluation device of claim 181 wherein bills meeting the certain criteria of having their denomination determined by the discriminating unit are delivered to a first set of one or more of the output receptacles and wherein no call bills are directed to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

185. The currency evaluation device of claim 184 wherein the processor is adapted to cause the transport mechanism to halt before a no call bill has been delivered to an output receptacle of the second set.

186. The currency evaluation device of claim 184 wherein the processor is adapted to cause the transport mechanism to halt after a no call bill has been delivered to an output receptacle of the second set.

187. The currency evaluation device of claim 186 wherein the processor is adapted to cause the transport mechanism to halt with a no call bill being positioned at an identifiable location in an output receptacle of the second set.

188. The currency evaluation device of claim 187 wherein the processor is adapted to cause the transport mechanism to halt with a no call bill being the last bill transported to an output receptacle of the second set.

189. The currency evaluation device of claim 164 wherein the discriminating unit is further adapted to determine whether bills are suspect and wherein the certain criteria include the discriminating unit determining a bill is suspect and wherein the processor is adapted to cause the transport mechanism to halt when a bill meets a criterion of being determined to be suspect by the discriminating unit, a bill being determined to be suspect being termed a suspect bill.

190. The currency evaluation device of claim 189 wherein bills whose denomination have been determined by the discriminating unit are delivered to a first set of one or more of the output receptacles and wherein suspect bills are directed to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

191. The currency evaluation device of claim 190 wherein the processor is adapted to cause the transport mechanism to halt after a suspect bill has been delivered to an output receptacle of the second set.

192. The currency evaluation device of claim 191 wherein the processor is adapted to cause the transport mechanism to halt with the suspect bill being positioned at an identifiable location in an output receptacle of the second set.

193. The currency evaluation device of claim 192 wherein the processor is adapted to cause the transport mechanism to halt with the suspect bill being the last bill transported to an output receptacle of the second set.

194. The currency evaluation device of claim 190 wherein bills whose denomination have not been determined by the discriminating unit are also delivered to an output receptacle of the second set.

195. The currency evaluation device of claim 194 wherein bills whose denomination have not been determined by the discriminating unit and the suspect bills are directed to different output receptacles of the second set.



196. The currency evaluation device of claim 194 wherein the processor is adapted not to halt the transport mechanism in response to the denomination of a bill not being determined.

197. The currency evaluation device of claim 190 wherein bills whose denomination have not been determined by the discriminating unit are directed to an output receptacle of the first set.

198. The currency evaluation device of claim 190 wherein the bills whose denomination have been determined and the bills whose denomination have not been determined by the discriminating unit are directed to different output receptacles of the first set.

199. The currency evaluation device of claim 164 wherein the certain criteria include the discriminating unit determining the denomination of a bill and wherein the processor is adapted to cause the transport mechanism to halt when a bill fails to meet a criterion of having its denomination determined by the discriminating unit, a bill failing to meet a criterion of having its denomination determined by the discriminating unit being termed a no call bill, and wherein the discriminating unit further determines whether bills are suspect.

200. The currency evaluation device of claim 199 wherein the processor is also adapted to cause the transport mechanism to halt when a bill meets a second criterion of being determined to be suspect by the discriminating unit.

201. The currency evaluation device of claim 200 wherein bills whose denomination have been determined by the discriminating unit are delivered to a first set of one or more of the output receptacles and wherein bills determined by the discriminating unit to be suspect and bills whose denomination have not been determined by the discriminating unit are directed to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

202. The currency evaluation device of claim 201 wherein the processor is adapted to cause the transport mechanism to halt after a no call bill or a suspect bill has been delivered to an output receptacle of the second set.

203. The currency evaluation device of claim 202 wherein the no call bills and suspect bills are delivered to different output receptacles of the second set.

204. The currency evaluation device of claim 202 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill or the suspect bill being the last bill transported to an output receptacle of the second set.

205. The currency evaluation device of claim 199 wherein bills whose denomination have been determined by the discriminating unit are delivered to a first set of one or more of the output receptacles and wherein bills whose denomination have not been determined by the discriminating unit are directed to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

206. The currency evaluation device of claim 205 wherein bills determined by the discriminating unit to be suspect are also delivered to an output receptacle of the second set.

207. The currency evaluation device of claim 205 wherein bills determined by the discriminating unit to be suspect are delivered to an output receptacle of the first set.

208. The currency evaluation device of claim 164 wherein genuine bills of the plurality of United States denominations having a plurality of images associated therewith, the plurality of images defining the plurality of United States denominations and wherein the discriminating unit is adapted to distinguish among the plurality of United States denominations by scanning the image associated with each of the bills.

209. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills to be evaluated;

two or more output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the output receptacles;

a discriminating unit adapted to count and denominate the bills including bills of a plurality of denominations, the discriminating unit including at least one detector positioned along the transport path between the input receptacle and the output receptacles; and

means for flagging a bill when the denomination of the bill is not determined by the discriminating unit, wherein the means for flagging is adapted to cause the transport mechanism to halt when a bill whose denomination has not been determined is encountered;

wherein the device is adapted to transport bills which have been denominated including bills of a plurality of denominations to a first set of one or more of the output receptacles.

210. The currency evaluation device of claim 209 wherein the currency bills comprise United States currency and the discriminating unit is adapted to denominate United States currency bills of a plurality of denominations.

211. The currency evaluation device of claim 209 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

212. The currency evaluation device of claim 209 wherein the currency bills of a plurality of denominations include bills of at least two of the denominations having the same dimensions.

213. The currency evaluation device of claim 209 wherein the means for flagging is adapted to cause the transport mechanism to halt with the bill whose denomination has not been determined being the last bill transported to one of the output receptacles.

214. The currency evaluation device of claim 209 wherein the device is adapted to transport bills which have not been denominated to a second set of one or more of the output

receptacles, the second set of the output receptacles being different than the first set of the output receptacles receiving bills which have been denominated.

215. The currency evaluation device of claim 214 wherein the first set and second set of the output receptacles have a stacking mechanism associated therewith and adapted to re-stack denominated bills in one of the first set of the output receptacle and re-stack bills which have not been denominated in one of the second set of the output receptacle.

216. The currency evaluation device of claim 209 wherein the detector of the discriminating unit includes a stationary optical scanning head adapted to scan at least a preselected segment of each bill transported between the input and output receptacles by the transport mechanism, and adapted to produce an output signal representing the scanned image and wherein the discriminating unit includes signal processing means adapted to receive the output signal and determine the denomination of each scanned bill.

217. The currency evaluation device of claim 209 wherein the transport mechanism is adapted to transport bills at a rate of at least about 800 bills per minute.

218. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- an input receptacle adapted to receive a stack of bills to be evaluated;

- two or more output receptacles adapted to receive the bills after the bills have been evaluated;

- a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the output receptacles;

- a discriminating unit including at least one detector positioned along the transport path between the input receptacle and output receptacle, the discriminating unit being adapted to count and determine the denomination of the bills and determine whether the bills are suspect; and

means for flagging a bill when the bill is determined to be suspect by the discriminating unit; wherein the means for flagging is adapted to cause the transport mechanism to halt when the discriminating unit determines that a bill is suspect.

219. The currency evaluation device of claim 218 wherein the currency bills comprise United States currency and the discriminating unit is adapted to denominate United States currency bills of a plurality of denominations.

220. The currency evaluation device of claim 218 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

221. The currency evaluation device of claim 218 wherein the means for flagging is adapted to cause the transport mechanism to halt when the discriminating unit determines that a bill is suspect with the bill which is determined to be suspect being the last bill transported to one of the output receptacles.

222. The currency evaluation device of claim 218 wherein the detector of the discriminating unit includes a stationary optical scanning head adapted to scan at least a preselected segment of each bill transported between the input and output receptacles by the transport mechanism and produce an output signal representing the scanned image, and wherein the discriminating unit includes a processor adapted to receive the output signal and determine the denomination of each scanned bill.

223. A high-speed, United States currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills to be evaluated;

two or more output receptacles adapted to receive the bills after the bills have been evaluated, at least one of the output receptacles being adapted to receive more than one denomination of bills;

a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the output receptacles at a rate in excess of 800 bills per minute;

a discriminating unit adapted to count and denominate the bills including United States currency bills of a plurality of denominations at a rate in excess of 800 bills per minute, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles;

a processor programmed to flag bills meeting or failing to meet any of certain non-piece count criteria, a bill meeting or failing to meet any of the criteria being termed a flagged bill; wherein the processor is adapted to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet a given one or ones of the criteria; and

wherein the processor is adapted to cause the transport mechanism to halt with a flagged bill meeting or failing to meet at least a given set of the criteria being positioned in one of the output receptacles.

224. The currency evaluation device of claim 223 wherein the processor is adapted to cause the transport mechanism to halt with a flagged bill being positioned as the last bill in one of the output receptacles.

225. The currency evaluation device of claim 223 wherein the processor is adapted to cause the transport mechanism to halt with a flagged bill being located at a predetermined position.

226. The currency evaluation device of claim 223 wherein the certain criteria include the discriminating unit determining the denomination of a bill, a bill failing to meet a criterion of having its denomination determined by the discriminating unit being termed a no call bill.

227. The currency evaluation device of claim 226 wherein the discriminating unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the certain criteria include the discriminating unit determining a bill is a stranger bill.

228. The currency evaluation device of claim 227 wherein no call bills are delivered to a first set of one or more of the output receptacles, and wherein stranger bills are delivered to a

second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

229. The currency evaluation device of claim 227 wherein the discriminating unit is further adapted to determine whether a bill is suspect and wherein the certain criteria include the discriminating unit determining a bill is suspect, a bill determined to be suspect being termed a suspect bill.

230. The currency evaluation device of claim 229 wherein no calls bills are delivered to a first output receptacle, wherein stranger bills are delivered to a second output receptacle, and wherein the suspect bills are delivered to a third output receptacle.

231. The currency evaluation device of claim 229 wherein the output receptacles include a third output receptacle, wherein no call bills and stranger bills are directed to the third receptacle, and suspect bills are directed to a second output receptacle.

232. The currency evaluation device of claim 231 wherein the processor is adapted to cause the transport mechanism to halt when a bill is directed to the third receptacle.

233. The currency evaluation device of claim 231 wherein the processor is adapted to cause the transport mechanism not to halt when a bill is directed to the third receptacle.

234. The currency evaluation device of claim 223 wherein the output receptacles include a third receptacle, and wherein the processor is adapted to cause the transport mechanism to deliver flagged bills to the third receptacle.

235. The currency evaluation device of claim 223 wherein the discriminating unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the certain criteria include the discriminating unit determining a bill is a stranger bill.

236. The currency evaluation device of claim 223 wherein the discriminating unit is further adapted to determine whether a bill is suspect and wherein the certain criteria include the discriminating unit determining a bill is suspect, a bill determined to be suspect being termed a suspect bill.

237. The currency evaluation device of claim 223 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

238. The currency evaluation device of claim 223 wherein bills of at least two of the denominations have the same dimensions.

239. The currency evaluation device of claim 223 wherein genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the discriminating unit is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

240. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

two or more output receptacles positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacles to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

a discriminating unit comprising a processor and at least one detector positioned along the transport path between the input receptacle and the output receptacles, the detector being adapted to generate a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor being adapted to receive the characteristic information output signal and generate a denomination signal in response thereto; and



a flagging device comprising a processor and an encoder linked to the transport mechanism, the encoder being adapted to produce tracking signals in response to the physical movement of the bills, the processor being adapted to generate a no call signal when the denomination of a bill is not determined by the processor; wherein the flagging device is adapted to generate a stopping signal in response to the no call signal and wherein the transport drive motor is adapted to stop in response to the stopping signal; and

wherein the device is adapted to transport bills which have been denominated to a first set of one or more of the output receptacles.

241. The currency evaluation device of claim 240 wherein the currency bills comprise United States currency and the discriminating unit is adapted to denominate United States currency bills of a plurality of denominations.

242. The currency evaluation device of claim 240 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

243. The currency evaluation device of claim 240 wherein the flagging device is adapted to cause the transport mechanism to stop with the bill whose denomination has not been determined being the last bill transported to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

244. The currency evaluation device of claim 240 wherein the device is adapted to transport bills which have not been denominated to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

245. The currency evaluation device of claim 244 wherein the first set and second set of the output receptacles have a stacking mechanism associated therewith and which is adapted to re-stack denominated bills in one of the first set of the output receptacle and re-stack bills which have not been denominated in one of the second set of the output receptacle.

246. The currency evaluation device of claim 240 further comprising a memory and wherein the processor is adapted to generate a scanned pattern from each of the bills based on the characteristic information output signal and determine the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, the master patterns being stored in the memory.

247. The currency evaluation device of claim 246 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

248. The currency evaluation device of claim 247 wherein the processor is adapted to correlate the scanned pattern generated from the bill with master patterns associated with different denominations of bills and determine the denomination of the bill if the scanned pattern sufficiently correlates with one of the master patterns.

249. The currency evaluation device of claim 240 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

250. The currency evaluation device of claim 240 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the discriminating unit is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

251. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle positioned to receive a stack of bills to be evaluated;

two or more output receptacles positioned to receive the bills after the bills have been evaluated;

a transport mechanism comprising a transport drive motor and transport rollers, the transport mechanism located between the input receptacle and the output receptacle to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

a discriminating unit comprising a detector positioned along the transport path between the input receptacle and the output receptacle and comprising a processor, the detector generating a characteristic information output signal in response to detected characteristic information, the characteristic information output signal being electrically coupled to the processor, the processor being adapted to receive the characteristic information output signal and generate a denomination signal in response thereto; the processor also being adapted to generate a suspect signal when a bill is determined to be suspect by the processor, and

a flagging device comprising a processor and an encoder linked to the transport mechanism, the encoder producing tracking signals in response to the physical movement of the bills; wherein the flagging device is adapted to generate a stopping signal in response to the suspect signal and wherein the transport drive motor is adapted to stop in response to the stopping signal.

252. The currency evaluation device of claim 251 wherein the input receptacle is adapted to receive and the processor is adapted to denominate bills of a plurality of United States denominations.

253. The currency evaluation device of claim 251 wherein the processor is adapted to denominate currency bills independently of the size of the bills.

254. The currency evaluation device of claim 251 wherein the processor is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

255. The currency evaluation device of claim 251 wherein the processor is adapted to denominate currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining

the plurality of denominations and wherein the processor is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

256. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills to be evaluated;

two or more output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, along a transport path from the input receptacle to the output receptacles;

a discriminating unit adapted to count and denominate the bills, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles; and

a processor programmed to cause the transport mechanism to halt in a predetermined manner in response to a determination that a bill meets a stranger bill criterion and in response to a determination that a bill meets a no call bill criterion, and wherein a bill which meets the stranger bill criterion is termed a stranger bill, and wherein a bill which meets the no call bill criterion is termed a no call bill.

257. The currency evaluation device of claim 256 wherein the currency bills comprise United States currency and the discriminating unit is adapted to denominate United States currency bills of a plurality of denominations.

258. The currency evaluation device of claim 256 wherein the discriminating unit is adapted to denominate the bills independent of the size of the bills.

259. The currency evaluation device of claim 256 wherein the transport mechanism is adapted to transport and the discriminating unit is adapted to denominate bills at a rate in excess of 800 bills per minute.

260. The currency evaluation device of claim 256 wherein the device is adapted to permit manual removal of a no call or a stranger bill after the transport mechanism has halted.

261. The currency evaluation device of claim 260 further comprising a key adapted to restart the operation of the device after the transport mechanism has halted.

**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of: )  
Richard A. Mazur, et al. ) Group Art Unit: 3653  
Serial No.: 09/541,170 ) Examiner: Mark J. Beauchaine  
Filed: April 3, 2000 ) Atty. Docket No.: 47171-00267  
For: APPARATUS WITH TWO OR MORE )  
POCKETS FOR DOCUMENT )  
PROCESSING )

**RESPONSE TO OFFICE ACTION DATED NOVEMBER 2, 2001**

COMMISSIONER FOR PATENTS  
Washington, D.C. 20231  
Attention: Box Responses-Fee

CERTIFICATE OF MAILING  
I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to the COMMISSIONER FOR PATENTS, BOX RESPONSES-FEE, Washington, D.C. 20231, on November 29, 2001.

11/29/01  
Date

Signature

Sir:

In response to the Office Action mailed November 2, 2001. The shortened statutory period for response is three months from the mailing date, *i.e.*, by February 2, 2002. The response is being filed within that time period. Please enter the following claim amendments and remarks into the record for this application as follows:

**IN THE CLAIMS:**

Please amend claims 306, 308 and 309 as follows:

306. (Twice Amended) The method of claim 296 wherein the output receptacles include a second receptacle, and further including delivering the bills meeting the stranger bill or no call bill criterion to the second output receptacle.

308. (Twice Amended) The method of claim 307 wherein the output receptacles include a second receptacle, and further including delivering stranger and no call bills to the second output receptacle and wherein suspect bills are delivered to the first output receptacle.

309. (Twice Amended) The method of claim 308 wherein the halting occurs when a bill meeting the no call criterion or the stranger criterion is delivered to the second output receptacle.

### **REMARKS**

Claims 164-311 are pending in the application. Claims 306, 308 and 309 have been amended to correct a typographical error. These amendments do not introduce new matter. Reconsideration of these claims in view of the remarks below is respectfully requested.

### **Information Disclosure Statement**

The Applicants have submitted concurrently herewith a Third Information Disclosure Statement and respectfully request that the Examiner review the enclosed references and make them of record.

### **Provisional Obviousness-Type Double Patenting Rejections**

Claims 164-311 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 164-311 of copending Application No. 09/542,487. Claim 204 has been provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 204 of copending Application No. 09/607,019. To obviate the provisional obviousness-type double patenting rejection, the Applicants are filing a terminal disclaimer herewith. To expedite

prosecution of the application, the Applicants have also included Application Nos. 09/611,279 in the 09/864,423 mentioned in the Office Action in the terminal disclaimer.

Therefore, the Applicants believe that claims 164-311 are in a condition for allowance.

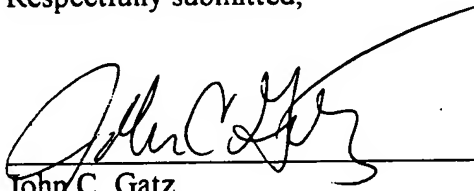
The Applicants have included clean and marked-up versions of the pending claims after entry of this amendment with the mailed copy of this Response.

### **CONCLUSION**

The Applicants submit that the claims are in a condition for allowance and action toward that end is earnestly solicited. The Commissioner is hereby authorized to charge deposit Account No. 10-0447 (47171-00267USC1) for any fees inadvertently omitted which may be necessary now or during the pendency of this application, except for the issue fee.

Dated: November 29, 2001

Respectfully submitted,



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**PENDING CLAIMS AFTER ENTRY OF  
RESPONSE TO 11/2/01 OFFICE ACTION**

164. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

- receiving a stack of bills in an input receptacle of the evaluation device;
- transporting the bills, one at a time, from the input receptacle to one of exactly two output receptacles of the currency evaluation device;
- counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;
- determining whether the bills meet or fail to meet a non-piece count related criterion;
- halting the transporting when a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill; and
- wherein the halting is performed such that the flagged bill is positioned as the last bill in one of the output receptacles.

165. The method of claim 164 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

166. The method of claim 164 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

167. The method of claim 164 further including receiving denominated bills of more than one denomination in at least one output receptacle.

168. The method of claim 164 wherein the halting occurs when the denomination of a bill is not determined, a bill whose denomination is not determined being termed a no call bill, and wherein the halting of the no call bill is positioned at an identifiable location in one of the output receptacles.

169. The method of claim 164 wherein bills whose denomination are determined are delivered to a first output receptacle and wherein bills whose denomination are not determined are directed to a second output receptacle, a bill whose denomination are not determined being termed a no call bill.

170. The method of claim 169 wherein the halting occurs after a no call bill has been delivered to the second output receptacle.

171. The method of claim 170 wherein the halting occurs with the no call bill being positioned at an identifiable location in the second output receptacle.

172. The method of claim 171 wherein the halting occurs with the no call bill being the last bill transported to the second output receptacle, wherein the criteria is the denomination of a bill and wherein a bill failing to meet the criterion of having its denomination determined is a flagged bill.

173. The method of claim 169 wherein the halting occurs before a no call bill has been delivered to the second output receptacle.

174. The method of claim 173 wherein the halting occurs with the no call bill being located at an identifiable location within the transport path.

175. The method of claim 164 further including determining whether a bill is a stranger bill, wherein a bill failing to have its denomination determined is termed a no call bill, and further including delivering stranger bills to a first output receptacle and delivering no call bills to the second output receptacle.

176. The method of claim 164 further including determining whether a bill is a stranger bill and wherein the non-piece count related criterion is a bill being a stranger bill.

177. The method of claim 164 further including determining whether a bill is suspect, a bill determined to be suspect being termed a suspect bill.

178. The method of claim 177 wherein bills whose denomination have been determined are delivered to a first output receptacle and wherein suspect bills are directed to the second output receptacle.

179. The method of claim 178 wherein the halting occurs before a suspect bill has been delivered to the second output receptacle.

180. The method of claim 179 wherein the halting occurs with the suspect bill being located at an identifiable location within the transport path.

181. The method of claim 178 wherein the halting occurs after a suspect bill has been delivered to the second output receptacle.

182. The method of claim 181 wherein the halting occurs with the suspect bill being positioned at an identifiable location in the second output receptacle.

183. The method of claim 182 wherein the halting occurs with the suspect bill being the last bill transported to the second output receptacle, and wherein the non-piece count criterion is a bill being suspect.

184. The method of claim 164 wherein the criterion is the denomination of the bill, a bill failing to have its denomination determined being termed a no call bill, and wherein the halting occurs with a no call bill as the last bill in one of the output receptacles.

185. The method of claim 164 wherein the criterion is a bill being a stranger bill, and wherein the halting occurs with a stranger bill as the last bill in one of the output receptacles.

186. The method of claim 164 wherein the criterion is a bill being a suspect bill, and wherein the halting occurs with a suspect bill as the last bill in one of the output receptacles.

187. The method of claim 164 wherein a bill failing to have its denomination determined being termed a no call bill, and further determining whether a bill is a suspect bill.

188. The method of claim 187 wherein the halting occurs when a bill is determined to be a suspect bill.

189. The method of claim 188 further including delivering bills whose denomination have been determined and suspect bills to a first output receptacle and delivering no call bills to a second output receptacle.

190. The method of claim 189 further including determining whether bills are stranger bills, and delivering stranger bills to the second output receptacle.

191. The method of claim 190 wherein the halting occurs after a no call bill or a stranger bill has been delivered to the second output receptacle.

192. The method of claim 191 wherein the halting occurs with the no call bill or the stranger bill being the last bill transported to the second output receptacle.

193. The method of claim 190 wherein the halting does not occur after a no call bill or a stranger bill has been delivered to the second output receptacle.

194. The method of claim 193 wherein the halting occurs after a suspect bill has been delivered to an output receptacle.

195. The method of claim 187 further including delivering bills whose denomination have been determined to a first output receptacle and delivering no call bills to a second output receptacle.

196. The method of claim 195 wherein the halting occurs after a no call bill has been delivered to the second output receptacle.

197. The method of claim 164 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

198. The method of claim 164 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

199. A method of evaluating a stack of currency bills and using the currency evaluation device comprising:

- receiving a stack of bills in an input receptacle of the evaluation device;
- transporting the bills, one at a time, from the input receptacle to one of exactly two output receptacles of the currency evaluation device along a transport path;
- providing a detector in the currency evaluation device that is positioned along the transport path between the input receptacle and the output receptacles, the detector being adapted to generate an output signal;
- counting and determining the denomination of the bills with the use of the output signal;
- determining whether the bills meet or fail to meet a non-piece count related criterion;
- halting the transporting when a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill; and
- wherein the halting is performed such that a flagged bill is positioned as the last bill in one of the output receptacles.

200. The method of claim 199 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

201. The method of claim 199 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

202. The method of claim 199 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

203. The method of claim 199 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

204. A method of evaluating a stack of currency bills and using the currency evaluation device comprising:

- receiving a stack of bills in an input receptacle of the evaluation device;

- transporting the bills, one at a time, from the input receptacle to one of exactly two output receptacles of the currency evaluation device along a transport path;

- counting and determining the denomination of the bills utilizing a detector positioned along the transport path between the input receptacle and the output receptacles;

- flagging a bill meeting or failing to meet any of a plurality of non-piece count related criteria;

- wherein the flagging comprises halting the transporting of the bills in response to a determination that a bill meets or fails to meet at least one of the criteria, the at least one criteria being termed a halting criterion, a bill meeting or failing to meet any of the criteria being termed a flagged bill; and

wherein the halting occurs with a bill satisfying the halting criteria being positioned as the last bill in one of the output receptacles.

205. The method of claim 204 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

206. The method of claim 204 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

207. The method of claim 204 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

208. The method of claim 204 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

209. A method of evaluating a stack of currency bills using a compact, high-speed United States currency evaluation device comprising:

receiving a stack of United States currency bills of a plurality of denominations in an input receptacle of the currency evaluation device;

transporting the bills, one at a time, from the input receptacle to one of exactly two output receptacles of the currency evaluation device at a rate of at least 800 bills per minute;

counting and determining the denomination of the bills including United States bills of a plurality of denominations at a rate of at least 800 bills per minute utilizing a detector positioned along a transport path between the input receptacle and the output receptacles; and

flagging bills that meet or fail to meet any of certain non-piece count related criteria, a bill meeting or failing to meet any of the criteria being termed a flagged bill; and

wherein the flagging comprises halting the transporting when a bill meets or fails to meet at least one of the criteria.

210. The method of claim 209 further including receiving denominated bills of more than one denomination in at least one output receptacle.

211. The method of claim 209 further including receiving denominated bills of more than one denomination in only one output receptacle.

212. The method of claim 209 wherein the halting occurs with a bill satisfying at least one criteria being positioned as the last bill in one of the output receptacles.

213. The method of claim 209 wherein one of the certain criteria is the denomination of a bill, a bill failing to meet the criterion of having its denomination determined being termed a no call bill, and wherein no call bills are flagged.

214. The method of claim 213 further including determining whether a bill is a stranger bill, wherein one of the certain criteria is a bill being a stranger bill and wherein stranger bills are flagged.

215. The method of claim 214 further including determining whether a bill is a suspect bill, wherein one of the certain criteria is a bill being a suspect bill and wherein suspect bills are flagged.

216. The method of claim 215 wherein the two output receptacles consist of a first output receptacle and a second output receptacle, and further directing stranger bills and no call bills to the first output receptacle and directing suspect bills to the second output receptacle.



217. The method of claim 216 wherein halting occurs when a no call bill or a stranger bill is delivered to the first output receptacle.

218. The method of claim 216 wherein halting does not occur when a no call bill or a stranger bill is delivered to the first output receptacle.

219. The method of claim 209 further including determining whether a bill is a stranger bill and wherein one of the certain criteria is a bill being a stranger bill, and wherein stranger bills are flagged.

220. The method of claim 209 further including determining whether a bill is a suspect bill, wherein one of the certain criteria is a bill being a suspect bill and wherein suspect bills are flagged.

221. The method of claim 209 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

222. The method of claim 209 wherein the halting occurs with a bill that meets or fails to meet the at least one criterion being positioned at an identifiable location in one of the output receptacles.

223. The method of claim 209 wherein the halting occurs with a bill that meets or fails to meet the at least one criterion being positioned at an identifiable location in the transport path.

224. The method of claim 209 wherein the halting occurs with a bill meeting or failing to meet the at least one criterion being located at a predetermined position.

225. The method of claim 209 wherein one of the certain criteria include the denomination of a bill and wherein the halting occurs when a bill fails to meet a criterion of having its denomination determined, a bill failing to meet the criterion of having its denomination determined being termed a no call bill.

226. The method of claim 225 wherein the halting occurs with a no call bill being positioned at an identifiable location in one of the output receptacles.

227. The method of claim 225 wherein the halting occurs with a no call bill being located at a predetermined position.

228. The method of claim 225 further including delivering bills meeting the certain criteria of having their denomination determined to a first output receptacle and directing no call bills to a second output receptacle.

229. The method of claim 228 wherein the halting occurs before a no call bill has been delivered to the second output receptacle.

230. The method of claim 228 wherein the halting occurs after a no call bill has been delivered to the second output receptacle.

231. The method of claim 230 wherein the halting occurs with a no call bill being positioned at an identifiable location in the second output receptacle.

232. The method of claim 231 wherein the halting occurs with a no call bill being the last bill transported to the second output receptacle.

233. The method of claim 209 further including determining whether bills are suspect bills and wherein the halting occurs when a bill meets a criterion of being determined to be a suspect bill.

234. The method of claim 233 further including delivering bills whose denominations have been determined to a first output receptacle and delivering suspect bills to a second output receptacle.

235. The method of claim 234 wherein the halting occurs after a suspect bill has been delivered to the second output receptacle.

236. The method of claim 235 wherein the halting occurs with a suspect bill being positioned at an identifiable location in the second output receptacle.

237. The method of claim 236 wherein the halting occurs with the suspect bill being the last bill transported to the second output receptacle.

238. The method of claim 234 further including delivering bills whose denomination have not been determined to the second output receptacle.

239. The method of claim 238 wherein the halting occurs in response to the denomination of a bill not being determined.

240. The method of claim 234 further including delivering bills whose denomination have not been determined to the first output receptacle.

241. The method of claim 209 wherein the certain criteria include the denomination of a bill and wherein the halting occurs when a bill fails to meet a criterion of having its denomination determined, a bill failing to meet a criterion of having its denomination determination being termed a no call bill, and further including determining whether bills are suspect.

242. The method of claim 241 wherein the halting occurs when a bill meets a second criterion of being determined to be suspect.

243. The method of claim 242 further including delivering bills whose denomination have been determined to a first output receptacle and directing bills determined to be suspect and bills whose denomination have not been determined to a second output receptacle.

244. The method of claim 243 wherein the halting occurs after a no call bill or a suspect bill has been delivered to the second output receptacle.

245. The method of claim 244 wherein the halting occurs with the no call bill or the suspect bill being the last bill transported to the second output receptacle.

246. The method of claim 241 further including delivering bills whose denomination have been determined to a first output receptacle and directing bills whose denomination have not been determined to a second output receptacle.

247. The method of claim 246 further including delivering suspect bills to the second output receptacle.

248. The method of claim 246 further including delivering suspect bills to the first output receptacle.

249. The method of claim 209 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

250. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of exactly two output receptacles of the currency evaluation device;

counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

flagging a bill when the denomination of the bills is not determined;

wherein the flagging comprises halting the transporting when a bill is flagged; and delivering bills that have been denominated including bills of a plurality of denominations to a first output receptacle.

251. The method of claim 250 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

252. The method of claim 250 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

253. The method of claim 250 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

254. The method of claim 250 wherein the halting occurs with the bill whose denomination has not been determined being the last bill transported to one of the output receptacles.

255. The method of claim 250 further including delivering bills that have not been denominated to a second output receptacle.

256. The method of claim 255 further including re-stacking denominated bills in a first output receptacle and re-stacking bills which have not been denominated in the second output receptacle.

257. The method of claim 250 wherein the detector includes a stationary optical scanning head, and further including scanning at least a preselected segment of each bill transported between the input and output receptacles along the transport path by the stationary optical scanning head, producing an output signal from the stationary optical scanning head representing the scanned

image, and wherein the determining of the denomination of each scanned bill utilizes the output signal.

258. The method of claim 250 wherein the transporting is performed at a rate of at least about 800 bills per minute.

259. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

- receiving a stack of bills in an input receptacle of the evaluation device;
- transporting the bills, one at a time, from the input receptacle to one of exactly two output receptacles of the currency evaluation device;
- counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles; and
- determining whether the bills are suspect;
- flagging a bill that has been determined to be suspect; and
- wherein the flagging comprises halting the transport mechanism when a bill is determined to be suspect.

260. The method of claim 259 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

261. The method of claim 259 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

262. The method of claim 259 wherein the halting occurs with the suspect bill being the last bill transported to one of the output receptacles.

263. The method of claim 259 wherein the detector includes a stationary optical scanning head and further including scanning at least a preselected segment of each bill transported between the input and output receptacles, producing an output signal representing the

scanned image, and wherein the determining of the denomination of each scanned bill utilizes the output signal.

264. A method of evaluating a stack of currency bills using a high-speed United States currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the currency evaluation device;

transporting the bills, one at a time, from the input receptacle to one of exactly two output receptacles of the currency evaluation device at a rate of at least 800 bills per minute, at least one of the output receptacles being adapted to receive more than one denomination of bills;

counting and determining the denomination of the bills including United States bills of a plurality of denominations at a rate of at least 800 bills per minute, utilizing a detector positioned along a transport path between the input receptacle and the output receptacles; and

flagging bills that meet or fail to meet any of certain non-piece count related criteria, a bill meeting or failing to meet any of the criteria being termed a flagged bill; and

wherein the flagging comprises halting the transporting with a flagged bill that meets or fails to meet at least a given set of the criteria positioned in one of the output receptacles.

265. The method of claim 264 wherein the halting occurs with a flagged bill being positioned as the last bill in one of the output receptacles.

266. The method of claim 264 wherein the halting occurs with a flagged bill being located at a predetermined position.

267. The method of claim 264 wherein the certain criteria include the denomination of a bill, a bill failing to meet a criterion of having its denomination determined being termed a no call bill.

268. The method of claim 267 further including determining whether a bill is a stranger bill and wherein the certain criteria include a bill being a stranger bill.

269. The method of claim 268 further including delivering no call bills to a first output receptacle and delivering stranger bills to a second output receptacle.

270. The method of claim 268 further including determining whether a bill is a suspect bill and wherein the certain criteria include a bill being a suspect bill.

271. The method of claim 270 further including directing no call bills and stranger bills to a second output receptacle and directing suspect bills to the first output receptacle.

272. The method of claim 271 wherein the halting occurs when a bill is directed to the second output receptacle.

273. The method of claim 271 wherein the halting does not occur when a bill is directed to the second output receptacle.

274. The method of claim 264 further including delivering flagged bills to the second output receptacle.

275. The method of claim 264 further including determining whether a bill is a stranger bill and wherein the certain criteria include a bill being a stranger bill.

276. The method of claim 264 further including determining whether a bill is a suspect bill and wherein the certain criteria include a bill being a suspect bill.

277. The method of claim 264 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

278. The method of claim 264 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.



279. The method of claim 264 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

280. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

- receiving a stack of bills in an input receptacle of the evaluation device;
- transporting the bills, one at a time, from the input receptacle to one of exactly two output receptacles of the currency evaluation device along a transport path;
- counting and determining the denomination of the bills, utilizing at least one detector positioned along a transport path between the input receptacle and the output receptacles;
- generating a characteristic information output signal in response to detected characteristic information via the detector;
- electronically coupling the characteristic information output signal;
- receiving the characteristic information output signal;
- generating a denomination signal in response to the information output signal;
- producing tracking signals in response to the physical movement of the bills;
- generating a no call signal when the denomination of a bill is not determined;
- generating a stopping signal in response to the no call signal;
- stopping a transport drive motor in response to the stopping signal; and
- directing the bills which have been denominating to a first output receptacle.

281. The method of claim 280 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

282. The method of claim 280 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

283. The method of claim 280 wherein the stopping occurs with the bill whose denomination has not been determined being the last bill transported to one of the output receptacles.

284. The method of claim 280 further including directing bills which have not been denominated to a second output receptacle.

285. The method of claim 284 further including re-stacking denominated bills in the first output receptacle and re-stacking bills which have not been denominated in the second output receptacle.

286. The method of claim 280 further including generating a scanned pattern from each of the bills based on the characteristic information output signal, determining the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, and storing the master patterns.

287. The method of claim 286 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

288. The method of claim 287 further including correlating the scanned pattern generated from the bill with master patterns associated with different denominations of bills and determining the denomination of the bill if the scanned pattern sufficiently correlates with one of the master patterns.

289. The method of claim 280 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

290. The method of claim 280 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the

plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

291. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

- receiving a stack of bills in an input receptacle of the evaluation device;
- transporting the bills, one at a time, from the input receptacle to one of exactly two output receptacles of the currency evaluation device;
- counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;
- generating a characteristic information output signal in response to detected characteristic information via the detector;
- electronically coupling the characteristic information output signal;
- receiving the characteristic information output signal;
- generating a denomination signal in response to the information output signal;
- generating a suspect signal when a bill is determined to be suspect;
- producing tracking signals in response to the physical movement of the bills;
- generating a stopping signal in response to the suspect signal; and
- stopping a transport drive motor in response to the stopping signal.

292. The method of claim 291 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

293. The method of claim 291 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

294. The method of claim 291 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

295. The method of claim 291 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

296. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of exactly two output receptacles of the currency evaluation device;

counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

halting the transporting in a predetermined manner in response to a determination that a bill meets a stranger bill criterion and in response to a determination that a bill meets a no call bill criterion; and

wherein a bill which meets the stranger bill criterion is termed a stranger bill, and wherein a bill which meets the no call bill criterion is termed a no call bill.

297. The method of claim 296 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

298. The method of claim 296 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

299. The method of claim 296 wherein the transporting, counting and determining of the currency bills is performed at a rate in excess of 800 bills per minute.

300. The method of claim 296 further including permitting manual removal of a no call or a stranger bill after halting the transporting.

301. The method of claim 300 further comprising restarting the operation of the device via a key after halting the transporting.

302. The method of claim 296 wherein the halting occurs with the bill meeting the stranger bill or no call bill criterion being positioned in one of the output receptacles.

303. The method of claim 296 wherein the halting occurs with the bill meeting the stranger bill or no call bill criterion being positioned as the last bill in one of the output receptacles.

304. The method of claim 296 wherein the halting occurs with the bill meeting the stranger bill or no call bill criterion being located at a predetermined position.

305. The method of claim 296 further including directing denominated currency bills of more than one denomination to at least one of the output receptacles.

306. The method of claim 296 wherein the output receptacles include a second receptacle, and further including delivering the bills meeting the stranger bill or no call bill criterion to the second output receptacle.

307. The method of claim 296 further including determining whether bills are suspect and wherein one of a criterion is a bill being a suspect bill.

308. The method of claim 307 wherein the output receptacles include a second receptacle, and further including delivering stranger and no call bills to the second output receptacle and wherein suspect bills are delivered to the first output receptacle.

309. The method of claim 308 wherein the halting occurs when a bill meeting the no call criterion or the stranger criterion is delivered to the second output receptacle.

310. The method of claim 296 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

311. The method of claim 296 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

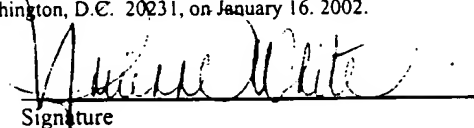
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: . . . )  
Richard A. Mazur, et al. ) Group Art Unit: 3651  
Serial No.: 09/607,019 ) Examiner: Jeffrey A. Shapiro  
Filed: June 29, 2000 ) Atty. Docket No.: 47171-00268USC1  
For: APPARATUS WITH TWO OR MORE )  
POCKETS FOR DOCUMENT )  
PROCESSING )

**RESPONSE TO OFFICE ACTION DATED NOVEMBER 7, 2001**

COMMISSIONER FOR PATENTS  
Washington, D.C. 20231  
Attention: Box Responses-No Fee

<b>CERTIFICATE OF MAILING</b>	
I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to the COMMISSIONER FOR PATENTS, BOX RESPONSES-NO FEE, Washington, D.C. 20231, on January 16, 2002.	
01/16/02 Date	 Signature

Sir:

In response to the Office Action mailed November 7, 2001. The shortened statutory period for response is three months from the mailing date, *i.e.*, by February 7, 2002. The response is being filed within that time period. Please enter the following claim amendment and remarks into the record for this application as follows:

**IN THE CLAIMS:**

Please amend claim 164 as follows:

164. (Amended) A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:  
an input receptacle adapted to receive a stack of bills to be evaluated;  
[exactly] two or more output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

a discriminating unit adapted to count and denominate the bills, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles; and

a processor programmed to determine whether the bills meet or fail to meet a non-piece count related criterion, the processor being programmed to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill, the processor being adapted to cause the transport mechanism to halt with a flagged bill being positioned as the last bill in one of the output receptacles.

### **REMARKS**

Claims 164-213 are pending in the application. Claim 164 has been amended. Reconsideration of these claims in view of the remarks below is respectfully requested.

#### **I. Obviousness-Type Double Patenting Rejections**

Claims 164-213 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over the claims of the following U.S. Patent Nos. 5,295,196; 5,430,664; 5,467,405; 5,790,697; 5,806,650; 5,815,592; 5,867,589; 5,870,487; 5,875,259; 5,905,810; 5,992,601; 6,012,565; 6,073,744; 6,220,419 B1; 6,237,739 B1; 6,241,069 B1; 6,278,795 B1 and 6,311,819. To formulate an obviousness-type double patenting rejection, the claims of the pending application must be compared to the claims of an application or a patent. See MPEP 804. In the Office Action, none of the claims of the above-identified U.S. patents has been specifically identified as relating to the obviousness-type double patenting rejections. In order to allow the Applicants to adequately respond to this rejection, the Applicants respectfully request an identification of the specific claim(s) of each of the above-



identified U.S. patents or, alternatively, for these obviousness-type double patenting rejections to be withdrawn.

#### Provisional Obviousness-Type Double Patenting Rejections

Claims 164-213 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 and 164-327 of copending Application Nos. 09/541,170 and 09/542,487; claims 157, 158 and 164-190 of copending Application No. 09/635,967; claims 164-337 of copending Application No. 09/607,019; claims 1-145 of copending Application No. 09/684,103; and claims of Application No. 09/126,580.

To obviate some of the provisional obviousness-type double patenting rejections, the Applicants will file a terminal disclaimer with respect to Application Nos. 09/541,170, and 09/542,487 when the other rejections have been withdrawn. The Applicants note that copending Application No. 09/607,019 is the present application and, thus, the obviousness-type double patenting rejection should be withdrawn to this application.

With respect to the remaining provisional obviousness-type double patenting rejections, the Applicants respectfully request the withdrawal of such rejections because the claims of each of the applications have many elements that are not present in any of the claims of the present application. As discussed above, a provisional obviousness-type double patenting rejection involves comparing the claims of the present application to that of a second application.

Specifically, the claims of Application No. 09/684,103 differ from the claims of the present application. For example, claim 1 of Application No. 09/684,103 recites several elements that are not recited in the present invention (*e.g.*, "detecting the presence or absence of

magnetic ink in a plurality of zones," and "comparing the detected information concerning which zones contained magnetic ink...."). Other claims of Application No. 09/684,103 recite some of the same elements, as well as additional elements that are not recited in the present application including elements directed to a magnetic scanhead, a memory adapted to store master security thread location and detecting the presence of a security thread. The claims of the present application also have elements that are not present in the claims of Application No. 09/684,103.

The claims of Application No. 09/635,967 also differ from the claims of the present application. For example, claim 1 of Application No. 09/635,967 recites several elements that are not recited in the present invention (*e.g.*, "a memory adapted to store information associated with a plurality of modes of operation of the device", "the memory being designed to store at least one user-defined mode of operation", "the user-mode of operation being capable of subsequent recall and selection of a user....", "an interface adapted to permit a user of the evaluation device to define the user-defined mode of operation" and "a mode selection element"). Other claims of Application No. 09/635,967 recite some of the same elements, as well as additional elements not recited in the claims of the present application. The claims of the present application also have elements that are not present in the claims of Application No. 09/635,967.

The claims of Application No. 09/126,580 differ from the claims of the present application. For example, claim 1 of Application No. 09/126,580 recites several limitations that are not recited in the present invention (*e.g.*, "a control panel having an input device adapted to receive input from an operator of the device" and "a processor...programmed to...enable the operator, upon suspension of the operation of the device to designate via the control panel the

denomination of a bill whose denomination is not determined by the processor" and "enable the operator, upon suspension of the operation of the device, to restart the operation of the device without designating the denomination of a bill whose denomination is not determined by the processor)". Other claims of Application No. 09/126,580 recite some of the same elements, as well as additional elements not recited in the claims of the present application. The claims of the present application also have limitations that are not present in the claims of Application No. 09/126,580.

Thus, the Applicants believe that the provisional obviousness-type double patenting rejections with respect to Application Nos. 09/684,103, 09/635,967 and 09/126,580 should be withdrawn.

The Applicants believe that Application No. 09/864,423 recited in the Office Action is not an application owned by the assignee of the present application. The Applicants note that Application No. 08/864,423 is an application owned by the assignee of the present application and issued as U.S. Patent No. 6,311,819, which was recited in the obviousness-type double patenting rejection.

## II. 35 U.S.C § 102 Rejections

Claims 164-213 were rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent No. 5,419,423 to Ishida et al. ("Ishida"), U.S. Patent No. 4,694,963 to Takesako ("Takesako"), U.S. Patent No. 5,201,395 to Takizawa et al. ("Takizawa"), U.S. Patent No. 5,301,786 to Yoshihara ("Yoshihara"), and U.S. Patent No. 5,761,089 to McInerny ("McInerny"). Claims 164-213 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 3,759,382 to Walkley et al. ("Walkley"). Each of these applied references is

missing at least one element from each of the recited independent claims (claims 164, 204 and 209). In fact, none of the applied references discloses a processor adapted to cause the transport mechanism to halt with a flagged bill as the last bill in one of the output receptacles.

Ishida, does not disclose, *inter alia*, (a) two or more output receptacles, (b) a discriminating unit adapted to count and denominate a stack of bills, and (c) a processor adapted to cause the transport mechanism to halt with a flagged bill as the last bill in one of the output receptacles. Rather, Ishida is directed to “a paper money processor” used “for determination of whether or not the inserted paper money is genuine.” Col. 2, lines 8-9 and col. 2, lines 20-21. It is clear that the device of Ishida does not have two or more output receptacles. See, *e.g.*, col. 4, lines 22-25 (“the paper money [is] fed through the paper money transporter section 4 into a paper money accommodation box 6”). Thus, claims 164-213 are not anticipated by or obvious over Ishida.

Takesako, does not disclose, *inter alia*, a processor adapted to cause the transport mechanism to halt with a flagged bill as the last bill in one of the output receptacles. Rather, in Takesako, bills that are not recognized or that do not fit under preset criteria are referred to as “reject bills” and “are stacked in the reject stacker 22.” Col. 7, lines 57-58. In fact, the device in Takesako appears to be designed to halt only when a preset number of bills is reached in one of the output receptacles. See, *e.g.*, col. 2, lines 47-50 (“when bills corresponding in quantity to the stack capacity or to a specified quantity less than the stack capacity . . . the sorting operation is automatically interrupted”), and col. 10, lines 57-61 (“[t]he restart key 84 is operated for resuming the sorting operation on a lot of bills set in the feeder 12 after it has been interrupted in

such a case as when the specified quantity is stacked in the stacker 18 or 20."'). Thus, claims 164-213 are not anticipated by or obvious over Takesako.

Takizawa, does not disclose, *inter alia*, (a) an input receptacle adapted to receive a stack of bills, (b) a discriminating unit adapted to count the bills, and (c) a processor adapted to cause the transport mechanism to halt with a flagged bill as the last bill in one of the output receptacles. Rather, Takizawa is directed to "a bill examination device used in an automatic cash deposit/dispensation machine or an automatic vending machine". Col. 1, lines 5-9 and col, 2, lines 23-28. It is clear that the device of Takizawa does not have an input receptacle adapted to receive a stack of bills. See, *e.g.*, col. 1, lines 11-17 ("[w]hen a bill (i.e., bank note or paper currency) is inserted or entered by a customer into an automatic cash deposit/dispensation machine or an automatic vending machine, the denomination of the bill is identified and the authenticity of the bill is tested.'). Thus, claims 164-213 are not anticipated by or obvious over Takizawa.

As discussed above with respect to Takizawa, Yoshihara also does not disclose, *inter alia*, (a) an input receptacle adapted to receive a stack of bills, (b) a discriminating unit adapted to count the bills, and (c) a processor adapted to cause the transport mechanism to halt with a flagged bill as the last bill in one of the output receptacles. Rather, Yoshihara is directed to "validating a paper-like piece such as a bill or bank note, a note used as a substitute for money, a gift card or a bill made of plastics..." Col. 1, lines 9-12 and col. 3, lines 64-68. It is clear that the device of Yoshihara, as shown in, for example, FIG. 5, does not have an input receptacle adapted to receive a stack of bills, but rather appears to be used in a similar manner as Takizawa

(i.e., in a automatic cash deposit/dispensation machine or an automatic vending machine). Thus, claims 164-213 are not anticipated by or obvious over Yoshihara.

McInerny, does not disclose, *inter alia*, (a) two or more output receptacles, (b) a discriminating unit adapted to denominate the bills, and (c) a processor adapted to cause the transport mechanism to halt with a flagged bill as the last bill in one of the output receptacles. McInery discloses a counterfeit document detection apparatus that includes only one output receptacle. See FIGs. 1 and 2a, and col. 3, line 58-col. 4, line 3. McInery does not denominate bills, but rather is a document counting and handling device that can count, verify and stack a particular type of document, such as currency of the same denomination. See generally col. 1, lines 18-20; col. 2, lines 3-7 and 34-40; col. 3, lines 58-63 and col. 11, line 65 to col. 12, line 43.

McInery not only does not disclose halting the transport mechanism with a flagged bill as the last bill in one of the output receptacles, but teaches away from such an element. See col. 21, lines 47-56 ("...the user is provided with an indication of a counterfeit suspect error in step 290 and the motor is halted. Since the document transport mechanism cannot be instantaneously stopped, both the counterfeit suspect and the next document in the input stack, if any, are delivered to the stacker as the motor is halted in step 290. The control procedure then passes to step 291 in which normal operation is resumed by removal of the counterfeit suspect and the next document from the stacker, placing the next document back into the hopper, and pressing the CONT key.") Thus, claims 164-213 are not anticipated by or obvious over McInery.

Walkley, does not disclose, *inter alia*, (a) a discriminating unit adapted to denominate a stack of bills, and (b) a processor adapted to cause the transport mechanism to halt with a flagged bill as the last bill in one of the output receptacles. Rather, Walkley is directed to an apparatus

for sorting currency according to bill fitness, which is measured according to the wear and tear of the bill, and for counting the bills as they pass through a monitoring station. Col. 4, lines 30-34 and col. 7, lines 3-5. The device in Walkley does not denominate the stack of bills. Similarly, the device in Walkley does not halt with a flagged bill being the last bill, but rather it sorts the stack of bills until a certain count is reached in one of the output receptacles. See, *e.g.*, col. 8, lines 37-49 (“each time fit counter 72 accumulates a count of one hundred, a fit full signal F Full is supplied to the feed logic circuitry 78, which responds by interrupting the feeding of currency.”). Thus, claims 164-213 are not anticipated by or obvious over Walkley.

Thus, independent claims 164, 204 and 209 are not anticipated by or rendered obvious over Ishida, Takesako, Takizawa, Yoshihara, McNery, Walkley or any combination thereof. Thus, claims 164, 204 and 209 should be in a condition for allowance. Claims 165-203, 205-208 and 210-213 which depend either directly or indirectly from claim 164, 204 or 209 should also be allowable for at least the same reasons.

### CONCLUSION

The Applicants submit that the claims are in a condition for allowance and action toward that end is earnestly solicited. The Commissioner is hereby authorized to charge deposit Account No. 10-0447 (47171-00268USC1) for any fees inadvertently omitted which may be necessary now or during the pendency of this application, except for the issue fee.

Dated: January 16, 2002

Respectfully submitted,



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Serial No. 09/607,019  
**(Clean) Pending Claims After 1/16/2002 Amendment**

164. (Amended) A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills to be evaluated;

two or more output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

a discriminating unit adapted to count and denominate the bills, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles; and

a processor programmed to determine whether the bills meet or fail to meet a non-piece count related criterion, the processor being programmed to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill, the processor being adapted to cause the transport mechanism to halt with a flagged bill being positioned as the last bill in one of the output receptacles.

165. The currency evaluation device of claim 164 wherein the input receptacle is adapted to receive and the discriminating unit is adapted to denominate bills of a plurality of United States denominations.

166. The currency evaluation device of claim 164 wherein the discriminating unit is adapted to denominate currency bills independently of the size of the bills.

167. The currency evaluation device of claim 164 wherein the device is adapted to deliver and at least one output receptacle is adapted to receive denominated bills of more than one denomination.

168. The currency evaluation device of claim 164 wherein the processor is adapted to cause the transport mechanism to halt when the discriminating unit is not able to determine the denomination of a bill, a bill whose denomination is not determined by the discriminating unit being termed a no call bill, the processor being adapted to cause the transport mechanism to halt with a no call bill being positioned at an identifiable location in one of the output receptacles.

169. The currency evaluation device of claim 164 wherein bills whose denomination are determined by the discriminating unit are delivered to a first set of one or more of the output receptacles and wherein bills whose denomination are not determined by the discriminating unit are directed to a second set of one or more of the output receptacles, bills whose denomination are not determined by the discriminating unit being termed no call bills, the output receptacles of the second set being different from the output receptacles of the first set.

170. The currency evaluation device of claim 169 wherein the second set of output receptacles includes a receptacle designated as a no call output receptacle.

171. The currency evaluation device of claim 170 wherein the processor is adapted to cause the transport mechanism to halt after a no call bill has been delivered to the no call output receptacle.

172. The currency evaluation device of claim 171 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill being positioned at an identifiable location in the no call output receptacle.

173. The currency evaluation device of claim 172 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill being the last bill transported to the no call output receptacle, wherein the criterion is the discriminating unit determining the denomination of a bill and wherein a bill failing to meet the criterion of having its denomination determined by the discriminating unit is a flagged bill.

174. The currency evaluation device of claim 170 wherein the processor is adapted to cause the transport mechanism to halt before a no call bill has been delivered to the no call output receptacle.

175. The currency evaluation device of claim 174 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill being located at an identifiable location within the transport mechanism.

176. The currency evaluation device of claim 169 wherein the processor is adapted to cause the transport mechanism to halt after the no call bill has been delivered to an output receptacle of the second set.

177. The currency evaluation device of claim 175 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill being positioned at an identifiable location in an output receptacle of the second set.

178. The currency evaluation device of claim 164 wherein a bill failing to have its denomination determined by the discriminating unit is termed a no call bill, wherein the discriminating unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill, and wherein the device is adapted to deliver stranger bills to a first set of one or more of the output receptacles and deliver no call bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

179. The currency evaluation device of claim 164 wherein the discrimination unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the non-piece count related criterion is the discriminating unit determining that a bill is a stranger bill.

180. The currency evaluation device of claim 164 wherein the discrimination unit is further adapted to determine whether a bill is suspect, a bill determined to be suspect being termed a suspect bill.

181. The currency evaluation device of claim 180 wherein bills whose denomination have been determined by the discriminating unit are delivered to a first set of one or more of the output receptacles and wherein suspect bills are directed to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

182. The currency evaluation device of claim 179 wherein the second set of output receptacles includes a receptacle designated as a suspect output receptacle.

183. The currency evaluation device of claim 182 wherein the processor is adapted to cause the transport mechanism to halt before a suspect bill has been delivered to the suspect output receptacle.

184. The currency evaluation device of claim 183 wherein the processor is adapted to cause the transport mechanism to halt with the suspect bill being located at an identifiable location within the transport mechanism.

185. The currency evaluation device of claim 181 wherein the processor is adapted to cause the transport mechanism to halt after a suspect bill has been delivered to the suspect output receptacle.

186. The currency evaluation device of claim 185 wherein the processor is adapted to cause the transport mechanism to halt with the suspect bill being positioned at an identifiable location in the suspect output receptacle.

187. The currency evaluation device of claim 186 wherein the processor is adapted to cause the transport mechanism to halt with the suspect bill being the last bill transported to the suspect output receptacle, wherein the non-piece count criterion is a bill being suspect.

188. The currency evaluation device of claim 164 wherein the criterion is the discriminating unit determining the denomination of the bill, a bill failing to have its denomination determined by the discriminating unit being termed a no call bill, and wherein the processor is adapted to cause the transport mechanism to halt with a no call bill as the last bill in a second set of one or more of the output receptacles.

189. The currency evaluation device of claim 164 wherein the discrimination unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the criterion is a bill being a stranger bill, and wherein the processor is adapted to cause the transport mechanism to halt with a stranger bill as the last bill in a second set of one or more of the output receptacles.

190. The currency evaluation device of claim 164 wherein the criterion is a bill being suspect, and wherein the processor is adapted to cause the transport mechanism to halt with a suspect bill as the last bill in a second set of one or more of the output receptacles.

191. The currency evaluation device of claim 164 wherein a bill failing to have its denomination determined by the discriminating unit being termed a no call bill, and wherein the discriminating unit is further adapted to determine whether a bill is suspect.

192. The currency evaluation device of claim 191 wherein the processor is adapted to cause the transport mechanism to halt when a bill is determined to be suspect by the discriminating unit, a bill determined to be suspect by the discriminating unit being termed a suspect bill.

193. The currency evaluation device of claim 192 wherein bills whose denomination have been determined by the discriminating unit and suspect bills are delivered to a first set of one or more of the output receptacles and wherein no call bills are delivered to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

194. The currency evaluation device of claim 191 wherein the second set of output receptacles consists of a single output receptacle.

195. The currency evaluation device of claim 193 wherein the discrimination unit is further adapted to determine whether a bill has a denomination other than a target denomination, a bill having a denomination other than the target denomination being termed a stranger bill and wherein the discriminating unit further is adapted to determine whether bills are stranger bills, and wherein stranger bills are delivered to an output receptacle of the second set.

196. The currency evaluation device of claim 195 wherein the processor is adapted to cause the transport mechanism to halt after a no call bill or a stranger bill has been delivered to an output receptacle of the second set.

197. The currency evaluation device of claim 196 wherein the processor is adapted to cause the transport mechanism to halt with the no call bill or the stranger bill being the last bill transported to an output receptacle of the second set.

198. The currency evaluation device of claim 195 wherein the processor is adapted to cause the transport mechanism not to halt after a no call bill or a stranger bill has been delivered to an output receptacle of the second set.

199. The currency evaluation device of claim 198 wherein the processor is adapted to cause the transport mechanism to halt after a suspect bill has been delivered to an output receptacle of the first set.

200. The currency evaluation device of claim 191 wherein bills whose denomination have been determined by the discriminating unit are delivered to a first set of one or more of the output receptacles and wherein no call bills are delivered to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

201. The currency evaluation device of claim 200 wherein the processor is adapted to cause the transport mechanism to halt after a no call bill has been delivered to an output receptacle of the second set.

202. The currency evaluation device of claim 164 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

203. The currency evaluation device of claim 164 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the discriminating unit is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

204. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

an input receptacle adapted to receive a stack of bills to be evaluated;

two or more output receptacles adapted to receive the bills after the bills have been evaluated;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

a detector positioned along the transport path between the input receptacle and the output receptacles, the detector being adapted to generate an output signal; and

a processor adapted to receive the output signal and programmed to count and denominate the bills and programmed to determine whether the bills meet or fail to meet a non-piece count related criterion, the processor being programmed to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill, the processor being adapted to cause the transport mechanism to halt with a flagged bill being positioned as the last bill in one of the output receptacles.

205. The currency evaluation device of claim 204 wherein the input receptacle is adapted to receive and the processor is adapted to denominate bills of a plurality of United States denominations.

206. The currency evaluation device of claim 204 wherein the processor is adapted to denominate currency bills independently of the size of the bills.

207. The currency evaluation device of claim 204 wherein the processor is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

208. The currency evaluation device of claim 204 wherein the processor is adapted to denominate currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the processor is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

209. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- an input receptacle adapted to receive a stack of bills to be evaluated;
- two or more output receptacles adapted to receive the bills after the bills have been evaluated;



a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the output receptacles along a transport path;

a discriminating unit adapted to count and denominate the bills, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacles; and

a processor programmed to flag bills meeting or failing to meet any of a plurality of non-piece count related criteria; wherein the processor is adapted to cause the transport mechanism to halt in response to a determination that a bill meets or fails to meet at least one of the criteria, the at least one criteria being termed a halting criterion, a bill meeting or failing to meet any of the criteria being termed a flagged bill, the processor being adapted to cause the transport mechanism to halt with a bill satisfying the halting criteria being positioned as the last bill in one of the output receptacles.

210. The currency evaluation device of claim 209 wherein the input receptacle is adapted to receive and the discriminating unit is adapted to denominate bills of a plurality of United States denominations.

211. The currency evaluation device of claim 209 wherein the discriminating unit is adapted to denominate currency bills independently of the size of the bills.

212. The currency evaluation device of claim 209 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

213. The currency evaluation device of claim 209 wherein the discriminating unit is adapted to denominate currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations and wherein the discriminating unit is adapted to distinguish among the plurality of denominations by scanning the image associated with each of the bills.

**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of:

Lars R. Stromme, et al.

Attorney Docket: 47171-00269USC1

Serial No.: 09/611,279

Group Art: 3652

Filed: July 6, 2000

Examiner: J. Shapiro

Title: Method for Document  
Processing

**RESPONSE TO OFFICE ACTION DATED NOVEMBER 7, 2001**

COMMISSIONER FOR PATENTS  
Washington, D.C. 20231  
Attention: Box Responses-Fee

**CERTIFICATE OF MAILING**

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to the COMMISSIONER FOR PATENTS, BOX RESPONSES-FEE, Washington, D.C. 20231, on February 19, 2002.

2/19/2002

Date

Signature

Sir:

In response to the Office Action mailed November 7, 2001. The shortened statutory period for response is three months from the mailing date, *i.e.*, by February 7, 2002. The Applicants have submitted a petition for a one (1) month extension herewith extending the response period to March 7, 2002, and, thus, the response is timely. Please enter the following claim amendments and remarks into the record for this application as follows:

**IN THE CLAIMS:**

Please delete claims 1 and 330-337 without prejudice.

**REMARKS**

Claims 1 and 164-337 are pending in the application. Claims 1 and 330-337 have been cancelled without prejudice. The Applicant reserves the right to pursue these claims in another

application. Thus, claims 164-329 are currently pending in the application. Reconsideration of the claims in view of the following remarks is respectfully requested.

I. Obviousness-Type Double Patenting Rejections

Claims 164-329 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over the claims of the following U.S. Patent Nos. 5,295,196; 5,430,664; 5,467,405; 5,790,697; 5,806,650; 5,815,592; 5,867,589; 5,870,487; 5,875,259; 5,905,810; 5,992,601; 6,012,565; 6,073,744; 6,220,419 B1; 6,237,739 B1; 6,241,069 B1; 6,278,795 B1 and 6,311,819 B1. To formulate an obviousness-type double patenting rejection, the claims of the pending application must be compared to the claims of an application or a patent. See MPEP 804. In the Office Action, none of the claims of the above-identified U.S. patents has been specifically identified as relating to the obviousness-type double patenting rejections. In order to allow the Applicants to adequately respond to this rejection, the Applicants respectfully request an identification of the specific claim(s) of each of the above-identified U.S. patents or, alternatively, for these obviousness-type double patenting rejections to be withdrawn.

Provisional Obviousness-Type Double Patenting Rejections

Claims 164-329 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 and 164-327 of copending Application Nos. 09/541,170 and 09/542,487; claims 157, 158 and 164-190 of copending Application No. 09/635,967; claims 164-337 of copending Application No. 09/607,019; claims 1-145 of copending Application No. 09/684,103; and claims of Application No. 09/126,580.

To obviate some of the provisional obviousness-type double patenting rejections, the Applicants will file a terminal disclaimer with respect to Application Nos. 09/541,170, 09/542,487

and 09/607,019 when the other rejections have been withdrawn provided such terminal disclaimer remains necessary.

With respect to the remaining provisional obviousness-type double patenting rejections, the Applicants respectfully request the withdrawal of such rejections because the claims of each of the applications have many elements that are not present in any of the claims of the present application. As discussed above, a provisional obviousness-type double patenting rejection involves comparing the claims of the present application to that of a second application.

Specifically, the claims of Application No. 09/684,103 differ from the claims of the present application. For example, claim 1 of Application No. 09/684,103 recites several elements that are not recited in the present invention (*e.g.*, “detecting the presence or absence of magnetic ink in a plurality of zones,” and “comparing the detected information concerning which zones contained magnetic ink...”). Other claims of Application No. 09/684,103 recite some of the same elements, as well as additional elements that are not recited in the present application including elements directed to a magnetic scanhead, a memory adapted to store master security thread location and detecting the presence of a security thread. The claims of the present application also have elements that are not present in the claims of Application No. 09/684,103.

The claims of Application No. 09/635,967 also differ from the claims of the present application. For example, claim 1 of Application No. 09/635,967 recites several elements that are not recited in the present invention (*e.g.*, “a memory adapted to store information associated with a plurality of modes of operation of the device”, “the memory being designed to store at least one user-defined mode of operation”, “the user-mode of operation being capable of subsequent recall and selection of a user...”, “an interface adapted to permit a user of the evaluation device to

define the user-defined mode of operation” and “a mode selection element”). Other claims of Application No. 09/635,967 recite some of the same elements, as well as additional elements not recited in the claims of the present application. The claims of the present application also have elements that are not present in the claims of Application No. 09/635,967.

The claims of Application No. 09/126,580 differ from the claims of the present application. For example, claim 1 of Application No. 09/126,580 recites several limitations that are not recited in the present invention (e.g., “a control panel having an input device adapted to receive input from an operator of the device” and “a processor...programmed to...enable the operator, upon suspension of the operation of the device to designate via the control panel the denomination of a bill whose denomination is not determined by the processor” and “enable the operator, upon suspension of the operation of the device, to restart the operation of the device without designating the denomination of a bill whose denomination is not determined by the processor”). Other claims of Application No. 09/126,580 recite some of the same elements, as well as additional elements not recited in the claims of the present application. The claims of the present application also have limitations that are not present in the claims of Application No. 09/126,580.

Thus, the Applicants believe that the provisional obviousness-type double patenting rejections with respect to Application Nos. 09/684,103, 09/635,967 and 09/126,580 should be withdrawn.

The Applicants believe that Application No. 09/864,423 recited in the Office Action is not an application owned by the assignee of the present application. The Applicants note that Application No. 08/864,423 is an application owned by the assignee of the present application and

issued as U.S. Patent No. 6,311,819, which was recited in the obviousness-type double patenting rejection.

## II. 35 U.S.C § 102 Rejections

Claims 164-329 were rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent No. 5,419,423 to Ishida et al. ("Ishida"), U.S. Patent No. 4,694,963 to Takesako ("Takesako"), U.S. Patent No. 5,201,395 to Takizawa et al. ("Takizawa"), U.S. Patent No. 5,301,786 to Yoshihara ("Yoshihara"), and U.S. Patent No. 5,761,089 to McInerny ("McInerny"). Claims 164-213 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 3,759,382 to Walkley et al. ("Walkley"). Each of these applied references is missing at least one element from each of the recited independent claims (claims 164, 204, 209, 214, 259, 268, 273, 290, 301, 306, 322 and 326).

Ishida, Takizawa and Yoshihara do not disclose, *inter alia*, (a) receiving a stack of bills in an input receptacle and (b) counting the denomination of bills. Such features are recited in all of the independent claims of the present application.

Ishida is directed to "a paper money processor" used "for determination of whether or not the inserted paper money is genuine." Col. 2, lines 8-9 and col. 2, lines 20-21. Ishida discloses "the paper money [is] fed through the paper money transporter section 4 into a paper money accommodation box 6" at col. 4, lines 22-25. Thus, claims 164-329 are not anticipated by or obvious over Ishida.

Takizawa is directed to "a bill examination device used in an automatic cash deposit/dispensation machine or an automatic vending machine". Col. 1, lines 5-9 and col. 2, lines 23-28. The device of Takizawa does not have an input receptacle adapted to receive a stack

of bills. See, e.g., col. 1, lines 11-17 (“[w]hen a bill (i.e., bank note or paper currency) is inserted or entered by a customer into an automatic cash deposit/dispensation machine or an automatic vending machine, the denomination of the bill is identified and the authenticity of the bill is tested.”). Thus, claims 164-329 are not anticipated by or obvious over Takizawa.

Yoshihara is directed to “validating a paper-like piece such as a bill or bank note, a note used as a substitute for money, a gift card or a bill made of plastics...” Col. 1, lines 9-12 and col. 3, lines 64-68. It is clear that the device of Yoshihara, as shown in, for example, FIG. 5, does not have an input receptacle adapted to receive a stack of bills, but rather appears to be used in a similar manner as Takizawa (i.e., in a automatic cash deposit/dispensation machine or an automatic vending machine). Thus, claims 164-329 are not anticipated by or obvious over Yoshihara.

McInerny, does not disclose, *inter alia*, (a) two or more output receptacles and (b) determining the denomination of the bills. Such features are recited in all of the independent claims of the present application. McInerny discloses a counterfeit document detection apparatus that includes only one output receptacle. See FIGs. 1 and 2a, and col. 3, line 58-col. 4, line 3. McInerny does not denominate bills, but rather is a document counting and handling device that can count, verify and stack a particular type of document, such as currency of the same denomination. See generally col. 1, lines 18-20; col. 2, lines 3-7 and 34-40; col. 3, lines 58-63 and col. 11, line 65 to col. 12, line 43. Thus, claims 164-329 are not anticipated by or obvious over McInerny.

Walkley, does not disclose, *inter alia*, determining the denomination of the bills. Such a feature is recited in all of the independent claims of the present application. Rather, Walkley is

directed to an apparatus for sorting currency according to bill fitness, which is measured according to the wear and tear of the bill, and for counting the bills as they pass through a monitoring station. Col. 4, lines 30-34 and col. 7, lines 3-5. Thus, claims 164-213 are not anticipated by or obvious over Walkley.

Takesako, does not disclose, *inter alia*, (a) halting the transporting such that a flagged bill is the last bill in one of the output receptacles, (b) wherein the flagging comprises halting the transporting when a bill meets or fails to meet at least one of the criteria, (c) wherein the flagging comprises halting the transporting when a bill is flagged because the denomination of the bills is not determined or is a suspect bill, (d) stopping a transport drive motor in response to the stopping signal as a result of a no call signal or a suspect signal, (e) halting the transporting in a predetermined manner in response to a determination that a bill meets a stranger bill criterion and in response to a determination that a bill meets a no call bill criterion, (f) presenting no call bills in a third one of the output receptacles, (g) presenting bills not having the target denomination in a third one of the output receptacles, and (h) upon encountering a bill having neither the first target denomination nor the second target denomination, then stopping the operation of the device if both the first and second output receptacles have one or more bills therein. One or more of such features are disclosed in each of the independent claims of the present application.

Rather, in Takesako, bills that are not recognized or that do not fit under preset criteria are referred to as "reject bills" and "are stacked in the reject stacker 22." Col. 7, lines 57-58. In fact, the device in Takesako appears to be designed to halt only when a preset number of bills is reached in one of the output receptacles. See, *e.g.*, col. 2, lines 47-50 ("when bills corresponding in quantity to the stack capacity or to a specified quantity less than the stack capacity . . . the



sorting operation is automatically interrupted”), and col. 10, lines 57-61 (“[t]he restart key 84 is operated for resuming the sorting operation on a lot of bills set in the feeder 12 after it has been interrupted in such a case as when the specified quantity is stacked in the stacker 18 or 20.”). Thus, claims 164-329 are not anticipated by or obvious over Takesako.

Thus, pending independent claims 164, 204, 209, 214, 259, 268, 273, 290, 301, 306, 322 and 326 are not anticipated by or rendered obvious over Ishida, Takesako, Takizawa, Yoshihara, McInerny, Walkley or any combination thereof. Thus, independent claims 164, 204, 209, 214, 259, 268, 273, 290, 301, 306, 322 and 326 should be in a condition for allowance. Claims 165-203, 205-208, 210-213, 215-258, 260-267, 269-272, 274-289, 291-300, 302-305, 307-321, 323-325 and 327-329, which depend either directly or indirectly from claim 164, 204, 209, 214, 259, 268, 273, 290, 301, 306, 322 or 326 should also be allowable for at least the same reasons.

### **CONCLUSION**

The Applicants submit that the claims are in a condition for allowance and action toward that end is earnestly solicited. The Commissioner is hereby authorized to charge deposit Account No. 10-0447 (47171-00269USC1) for any fees inadvertently omitted which may be

necessary now or during the pendency of this application, except for the issue fee.

Dated: February 19, 2002.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "John C. Gatz", written over a horizontal line.

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**CLAIMS AFTER FEBRUARY 19, 2002 AMENDMENT (MARKED-UP)**

[1. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, said device comprising:

an input receptacle for receiving a stack of bills to be evaluated;

a plurality of output receptacles for receiving said bills after said bills have been evaluated;

a transport mechanism for transporting said bills, one at a time, from said input receptacle to one of said output receptacles along a transport path;

a discriminating unit for evaluating said bills, said discriminating unit including a detector positioned along said transport path between said input receptacle and said output receptacle, said discriminating unit counting and determining the denomination of said bills; and

means for flagging bills meeting or failing to meet a certain criteria; wherein said means for flagging causes said transport mechanism to halt in response to a determination that a bill meets or fails to meet said criteria, said bill meeting or failing to meet said criteria being termed a flagged bill.]

164. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;

counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

determining whether the bills meet or fail to meet a non-piece count related criterion;

halting the transporting when a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill; and

wherein the halting is performed such that the flagged bill is positioned as the last bill in one of the output receptacles.

165. The method of claim 164 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

166. The method of claim 164 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

167. The method of claim 164 further including receiving denominated bills of more than one denomination in at least one output receptacle.

168. The method of claim 164 wherein the halting occurs when the denomination of a bill is not determined, a bill whose denomination is not determined being termed a no call bill, and wherein the halting of the no call bill is positioned at an identifiable location in one of the output receptacles.

169. The method of claim 164 wherein bills whose denomination are determined are delivered to a first set of one or more of the output receptacles and wherein bills whose denomination are not determined are directed to a second set of one or more of the output receptacles, a bill whose denomination is not determined being termed a no call bill, the output receptacles of the second set being different from the output receptacles of the first set.

170. The method of claim 169 wherein the second set of output receptacles includes a receptacle designated as a no call output receptacle.

171. The method of claim 170 wherein the halting occurs after a no call bill has been delivered to the no call output receptacle.

172. The method of claim 171 wherein the halting occurs with the no call bill being positioned at an identifiable location in the no call output receptacle.

173. The method of claim 172 wherein the halting occurs with the no call bill being the last bill transported to the no call output receptacle, wherein the criteria is the denomination of a bill and wherein a bill failing to meet the criterion of having its denomination determined is a flagged bill.

174. The method of claim 170 wherein the halting occurs before a no call bill has been delivered to the no call output receptacle.

175. The method of claim 174 wherein the halting occurs with the no call bill being located at an identifiable location within the transport path.

176. The method of claim 169 wherein the halting occurs after the no call bill has been delivered to an output receptacle of the second set.

177. The method of claim 175 wherein the halting occurs with the no call bill being positioned at an identifiable location in an output receptacle of the second set.

178. The method of claim 164 further including determining whether a bill is a stranger bill, wherein a bill failing to have its denomination determined is termed a no call bill, and further including delivering stranger bills to a first set of one or more of the output receptacles and delivering no call bills to a second set of one or more output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

179. The method of claim 164 further including determining whether a bill is a stranger bill and wherein the non-piece count related criterion is a bill being a stranger bill.

180. The method of claim 164 further including determining whether a bill is suspect, a bill determined to be suspect being termed a suspect bill.

181. The method of claim 180 wherein bills whose denomination have been determined are delivered to a first set of one or more of the output receptacles and wherein suspect bills are directed to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

182. The method of claim 179 wherein the second set of output receptacles includes a receptacle designated as a suspect output receptacle.

183. The method of claim 182 wherein the halting occurs before a suspect bill has been delivered to the suspect output receptacle.

184. The method of claim 183 wherein the halting occurs with the suspect bill being located at an identifiable location within the transport path.

185. The method of claim 181 wherein the halting occurs after a suspect bill has been delivered to the suspect output receptacle.

186. The method of claim 185 wherein the halting occurs with the suspect bill being positioned at an identifiable location in the suspect output receptacle.

187. The method of claim 186 wherein the halting occurs with the suspect bill being the last bill transported to the suspect output receptacle, and wherein the non-piece count criterion is a bill being suspect.

188. The method of claim 164 wherein the criterion is the denomination of the bill, a bill failing to have its denomination determined being termed a no call bill, and wherein the halting occurs with a no call bill as the last bill in a second set of one or more of the output receptacles.

189. The method of claim 164 wherein the criterion is a bill being a stranger bill, and wherein the halting occurs with a stranger bill as the last bill in a second set of one or more of the output receptacles.

190. The method of claim 164 wherein the criterion is a bill being a suspect bill, and wherein the halting occurs with a suspect bill as the last bill in a second set of one or more of the output receptacles.

191. The method of claim 164 wherein a bill failing to have its denomination determined being termed a no call bill, and further determining whether a bill is a suspect bill.

192. The method of claim 191 wherein the halting occurs when a bill is determined to be a suspect bill.

193. The method of claim 192 further including delivering bills whose denomination have been determined and suspect bills to a first set of one or more of the output receptacles and delivering no call bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

194. The method of claim 191 wherein the second set of output receptacles consists of a single output receptacle.

195. The method of claim 193 further including determining whether bills are stranger bills, and delivering stranger bills to an output receptacle of the second set.

196. The method of claim 195 wherein the halting occurs after a no call bill or a stranger bill has been delivered to an output receptacle of the second set.

197. The method of claim 196 wherein the halting occurs with the no call bill or the stranger bill being the last bill transported to an output receptacle of the second set.

198. The method of claim 195 wherein the halting does not occur after a no call bill or a stranger bill has been delivered to an output receptacle of the second set.

199. The method of claim 198 wherein the halting occurs after a suspect bill has been delivered to an output receptacle of the first set.

200. The method of claim 191 further including delivering bills whose denomination have been determined to a first set of one or more of the output receptacles and delivering no call bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

201. The method of claim 200 wherein the halting occurs after a no call bill has been delivered to an output receptacle of the second set.

202. The method of claim 164 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

203. The method of claim 164 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

204. A method of evaluating a stack of currency bills and using the currency evaluation device comprising:



receiving a stack of bills in an input receptacle of the evaluation device;  
transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device along a transport path;  
providing a detector in the currency evaluation device that is positioned along the transport path between the input receptacle and the output receptacles, the detector being adapted to generate an output signal;  
counting and determining the denomination of the bills with the use of the output signal;  
determining whether the bills meet or fail to meet a non-piece count related criterion;  
halting the transporting when a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill; and  
wherein the halting is performed such that a flagged bill is positioned as the last bill in one of the output receptacles.

205. The method of claim 204 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

206. The method of claim 204 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

207. The method of claim 204 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

208. The method of claim 204 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

209. A method of evaluating a stack of currency bills and using the currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device along a transport path;

counting and determining the denomination of the bills utilizing a detector positioned along the transport path between the input receptacle and the output receptacles;

flagging a bill meeting or failing to meet any of a plurality of non-piece count related criteria;

wherein the flagging comprises halting the transporting of the bills in response to a determination that a bill meets or fails to meet at least one of the criteria, the at least one criteria being termed a halting criterion, a bill meeting or failing to meet any of the criteria being termed a flagged bill; and

wherein the halting occurs with a bill satisfying the halting criteria being positioned as the last bill in one of the output receptacles.

210. The method of claim 209 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

211. The method of claim 209 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

212. The method of claim 209 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

213. The method of claim 209 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

214. A method of evaluating a stack of currency bills using a compact, high-speed United States currency evaluation device comprising:

receiving a stack of United States currency bills of a plurality of denominations in an input receptacle of the currency evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device at a rate of at least 800 bills per minute;

counting and determining the denomination of the bills including United States bills of a plurality of denominations at a rate of at least 800 bills per minute utilizing a detector positioned along a transport path between the input receptacle and the output receptacles; and

flagging bills that meet or fail to meet any of certain non-piece count related criteria, a bill meeting or failing to meet any of the criteria being termed a flagged bill; and

wherein the flagging comprises halting the transporting when a bill meets or fails to meet at least one of the criteria.

215. The method of claim 214 further including receiving denominated bills of more than one denomination in at least one output receptacle.

216. The method of claim 214 further including receiving denominated bills of more than one denomination in only one output receptacle.

217. The method of claim 214 wherein the halting occurs with a bill satisfying at least one criteria being positioned as the last bill in one of the output receptacles.

218. The method of claim 214 wherein one of the certain criteria is the denomination of a bill, a bill failing to meet the criterion of having its denomination determined being termed a no call bill, and wherein no call bills are flagged.

219. The method of claim 218 further including determining whether a bill is a stranger bill, wherein one of the certain criteria is a bill being a stranger bill and wherein stranger bills are flagged.

220. The method of claim 219 further including determining whether a bill is a suspect bill, wherein one of the certain criteria is a bill being a suspect bill and wherein suspect bills are flagged.

221. The method of claim 220 further directing stranger bills and no call bills to a first set of one or more of the output receptacles and directing suspect bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

222. The method of claim 221 wherein the first set of output receptacles includes at least two output receptacles.

223. The method of claim 221 wherein halting occurs when a no call bill or a stranger bill is delivered to an output receptacle of the first set.

224. The method of claim 221 wherein halting does not occur when a no call bill or a stranger bill is delivered to an output receptacle of the first set.

225. The method of claim 214 further including determining whether a bill is a stranger bill and wherein one of the certain criteria is a bill being a stranger bill, and wherein stranger bills are flagged.

226. The method of claim 214 further including determining whether a bill is a suspect bill, wherein one of the certain criteria is a bill being a suspect bill and wherein suspect bills are flagged.

227. The method of claim 214 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

228. The method of claim 214 wherein the halting occurs with a bill that meets or fails to meet the at least one criterion being positioned at an identifiable location in one of the output receptacles.

229. The method of claim 214 wherein the halting occurs with a bill that meets or fails to meet the at least one criterion being positioned at an identifiable location in the transport path.

230. The method of claim 214 wherein the halting occurs with a bill meeting or failing to meet the at least one criterion being located at a predetermined position.

231. The method of claim 214 wherein one of the certain criteria include the denomination of a bill and wherein the halting occurs when a bill fails to meet a criterion of having its denomination determined, a bill failing to meet the criterion of having its denomination determined being termed a no call bill.

232. The method of claim 231 wherein the halting occurs with a no call bill being positioned at an identifiable location in one of the output receptacles.

233. The method of claim 231 wherein the halting occurs with a no call bill being located at a predetermined position.

234. The method of claim 231 further including delivering bills meeting the certain criteria of having their denomination determined to a first set of one or more of the output receptacles and directing no call bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

235. The method of claim 234 wherein the halting occurs before a no call bill has been delivered to an output receptacle of the second set.

236. The method of claim 234 wherein the halting occurs after a no call bill has been delivered to an output receptacle of the second set.

237. The method of claim 236 wherein the halting occurs with a no call bill being positioned at an identifiable location in an output receptacle of the second set.

238. The method of claim 237 wherein the halting occurs with a no call bill being the last bill transported to an output receptacle of the second set.

239. The method of claim 214 further including determining whether bills are suspect bills and wherein the halting occurs when a bill meets a criterion of being determined to be a suspect bill.

240. The method of claim 239 further including delivering bills whose denominations have been determined to a first set of one or more of the output receptacles and delivering suspect bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

241. The method of claim 240 wherein the halting occurs after a suspect bill has been delivered to an output receptacle of the second set.

242. The method of claim 241 wherein the halting occurs with a suspect bill being positioned at an identifiable location in an output receptacle of the second set.

243. The method of claim 242 wherein the halting occurs with the suspect bill being the last bill transported to an output receptacle of the second set.

244. The method of claim 240 further including delivering bills whose denomination have not been determined to an output receptacle of the second set.

245. The method of claim 244 further including directing bills whose denomination have not been determined by the discriminating unit and the suspect bills to different output receptacles of the second set.

246. The method of claim 244 wherein the halting occurs in response to the denomination of a bill not being determined.

247. The method of claim 240 further including delivering bills whose denomination have not been determined to an output receptacle of the first set.

248. The method of claim 240 further including directing the bills whose denomination have been determined and the bills whose denomination have not been determined by the discriminating unit to different output receptacles of the first set.

249. The method of claim 214 wherein the certain criteria include the denomination of a bill and wherein the halting occurs when a bill fails to meet a criterion of having its denomination determined, a bill-failing to meet a criterion of having its denomination determination being termed a no call bill, and further including determining whether bills are suspect.

250. The method of claim 249 wherein the halting occurs when a bill meets a second criterion of being determined to be suspect.

251. The method of claim 250 further including delivering bills whose denomination have been determined to a first set of one or more of the output receptacles and directing bills determined to be suspect and bills whose denomination have not been determined to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

252. The method of claim 251 wherein the halting occurs after a no call bill or a suspect bill has been delivered to an output receptacle of the second set.

253. The method of claim 252 wherein the no call bills and suspect bills are delivered to different output receptacles of the second set.

254. The method of claim 252 wherein the halting occurs with the no call bill or the suspect bill being the last bill transported to an output receptacle of the second set.

255. The method of claim 249 further including delivering bills whose denomination have been determined to a first set of one or more of the output receptacles and directing bills whose denomination have not been determined to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

256. The method of claim 255 further including delivering suspect bills to an output receptacle of the second set.

257. The method of claim 255 further including delivering suspect bills to an output receptacle of the first set.



258. The method of claim 214 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

259. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

- receiving a stack of bills in an input receptacle of the evaluation device;
- transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;
- counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;
- flagging a bill when the denomination of the bills is not determined;
- wherein the flagging comprises halting the transporting when a bill is flagged; and
- delivering bills that have been denominated including bills of a plurality of denominations to a first set of one or more of the output receptacles.

260. The method of claim 259 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

261. The method of claim 259 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

262. The method of claim 259 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

263. The method of claim 259 wherein the halting occurs with the bill whose denomination has not been determined being the last bill transported to one of the output receptacles.

264. The method of claim 259 further including delivering bills that have not been denominated to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

265. The method of claim 264 further including re-stacking denominated bills in an output receptacle of the first set and re-stacking bills which have not been denominated in an output receptacle of the second set.

266. The method of claim 259 wherein the detector includes a stationary optical scanning head, and further including scanning at least a preselected segment of each bill transported between the input and output receptacles along the transport path by the stationary optical scanning head, producing an output signal from the stationary optical scanning head representing the scanned image, and wherein the determining of the denomination of each scanned bill utilizes the output signal.

267. The method of claim 259 wherein the transporting is performed at a rate of at least about 800 bills per minute.

268. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;

counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles; and

determining whether the bills are suspect;

flagging a bill that has been determined to be suspect; and  
wherein the flagging comprises halting the transport mechanism when a bill is determined to be suspect.

269. The method of claim 268 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

270. The method of claim 268 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

271. The method of claim 268 wherein the halting occurs with the suspect bill being the last bill transported to one of the output receptacles.

272. The method of claim 268 wherein the detector includes a stationary optical scanning head and further including scanning at least a preselected segment of each bill transported between the input and output receptacles, producing an output signal representing the scanned image, and wherein the determining of the denomination of each scanned bill utilizes the output signal.

273. A method of evaluating a stack of currency bills using a high-speed United States currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the currency evaluation device;  
transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device at a rate of at least 800 bills per minute, at least one of the output receptacles being adapted to receive more than one denomination of bills;  
counting and determining the denomination of the bills including United States bills of a plurality of denominations at a rate of at least 800 bills per minute, utilizing a detector positioned along a transport path between the input receptacle and the output receptacles; and

flagging bills that meet or fail to meet any of certain non-piece count related criteria, a bill meeting or failing to meet any of the criteria being termed a flagged bill; and

wherein the flagging comprises halting the transporting with a flagged bill that meets or fails to meet at least a given set of the criteria positioned in one of the output receptacles.

274. The method of claim 273 wherein the halting occurs with a flagged bill being positioned as the last bill in one of the output receptacles.

275. The method of claim 273 wherein the halting occurs with a flagged bill being located at a predetermined position.

276. The method of claim 273 wherein the certain criteria include the denomination of a bill, a bill failing to meet a criterion of having its denomination determined being termed a no call bill.

277. The method of claim 276 further including determining whether a bill is a stranger bill and wherein the certain criteria include a bill being a stranger bill.

278. The method of claim 277 further including delivering no call bills to a first set of one or more of the output receptacles and delivering stranger bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

279. The method of claim 277 further including determining whether a bill is a suspect bill and wherein the certain criteria include a bill being a suspect bill.

280. The method of claim 279 wherein no calls bills are delivered to a first output receptacle, wherein stranger bills are delivered to a second output receptacle, and wherein the suspect bills are delivered to a third output receptacle.

281. The method of claim 279 wherein the output receptacles include a third output receptacle and further including directing no call bills and stranger bills to the third output receptacle and directing suspect bills to a second output receptacle.

282. The method of claim 281 wherein the halting occurs when a bill is directed to the third output receptacle.

283. The method of claim 281 wherein the halting does not occur when a bill is directed to the third output receptacle.

284. The method of claim 273 wherein the output receptacles include a third output receptacle and further including delivering flagged bills to the second output receptacle.

285. The method of claim 273 further including determining whether a bill is a stranger bill and wherein the certain criteria include a bill being a stranger bill.

286. The method of claim 273 further including determining whether a bill is a suspect bill and wherein the certain criteria include a bill being a suspect bill.

287. The method of claim 273 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

288. The method of claim 273 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

289. The method of claim 273 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality

of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

290. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

- receiving a stack of bills in an input receptacle of the evaluation device;
- transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device along a transport path;
- counting and determining the denomination of the bills, utilizing at least one detector positioned along a transport path between the input receptacle and the output receptacles;
- generating a characteristic information output signal in response to detected characteristic information via the detector;
- electronically coupling the characteristic information output signal;
- receiving the characteristic information output signal;
- generating a denomination signal in response to the information output signal;
- producing tracking signals in response to the physical movement of the bills;
- generating a no call signal when the denomination of a bill is not determined;
- generating a stopping signal in response to the no call signal;
- stopping a transport drive motor in response to the stopping signal; and
- directing the bills which have been denominated to a first set of one or more of the output receptacles.

291. The method of claim 290 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations. -

292. The method of claim 290 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

293. The method of claim 290 wherein the stopping occurs with the bill whose denomination has not been determined being the last bill transported to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

294. The method of claim 290 further including directing bills which have not been denominated to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

295. The method of claim 294 further including re-stacking denominated bills in one of the first set of output receptacles and re-stacking bills which have not been denominated in one of the second set of the output receptacles.

296. The method of claim 290 further including generating a scanned pattern from each of the bills based on the characteristic information output signal, determining the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, and storing the master patterns.

297. The method of claim 296 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

298. The method of claim 297 further including correlating the scanned pattern generated from the bill with master patterns associated with different denominations of bills and determining the denomination of the bill if the scanned pattern sufficiently correlates with one of the master patterns.

299. The method of claim 290 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

300. The method of claim 290 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

301. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

- receiving a stack of bills in an input receptacle of the evaluation device;
- transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;
- counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;
- generating a characteristic information output signal in response to detected characteristic information via the detector;
- electronically coupling the characteristic information output signal;
- receiving the characteristic information output signal;
- generating a denomination signal in response to the information output signal;
- generating a suspect signal when a bill is determined to be suspect;
- producing tracking signals in response to the physical movement of the bills;
- generating a stopping signal in response to the suspect signal; and
- stopping a transport drive motor in response to the stopping signal.



302. The method of claim 301 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

303. The method of claim 301 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

304. The method of claim 301 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

305. The method of claim 301 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

306. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;

counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

halting the transporting in a predetermined manner in response to a determination that a bill meets a stranger bill criterion and in response to a determination that a bill meets a no call bill criterion; and

wherein a bill which meets the stranger bill criterion is termed a stranger bill, and wherein a bill which meets the no call bill criterion is termed a no call bill.

307. The method of claim 306 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

308. The method of claim 306 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

309. The method of claim 306 wherein the transporting, counting and determining of the currency bills is performed at a rate in excess of 800 bills per minute.

310. The method of claim 306 further including permitting manual removal of a no call or a stranger bill after halting the transporting.

311. The method of claim 310 further comprising restarting the operation of the device via a key after halting the transporting.

312. The method of claim 306 wherein the halting occurs with the bill meeting the stranger bill or non call bill criterion being positioned in one of the output receptacles.

313. The method of claim 306 wherein the halting occurs with the bill meeting the stranger bill or no call bill criterion being positioned as the last bill in one of the output receptacles.

314. The method of claim 306 wherein the halting occurs with the bill meeting the stranger bill or no call bill criterion being located at a predetermined position.

315. The method of claim 306 further including directing denominated currency bills of more than one denomination to at least one of the output receptacles.

316. The method of claim 306 wherein the output receptacles include a second output receptacle, and further including delivering the bills meeting the stranger bill or no call bill criterion to the second output receptacle.

317. The method of claim 306 further including determining whether bills are suspect and wherein one of a criterion is a bill being a suspect bill.

318. The method of claim 317 wherein the output receptacles include second and third output receptacles, and further including delivering stranger and no call bills to the second output receptacle and wherein suspect bills are delivered to the third output receptacle.

319. The method of claim 318 wherein the halting occurs when a bill meeting the no call criterion or the stranger criterion is delivered to the second output receptacle.

320. The method of claim 306 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

321. The method of claim 306 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

322. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;

counting and determining the denomination of the bills including bills of a plurality of denominations utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

routing bills having a target denomination to one of the first output receptacles,

routing bills having any other of the plurality of denominations to a second one of the output receptacles; and

presenting no call bills in a third one of the output receptacles.

323. The method of claim 313 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

324. The method of claim 313 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

325. The method of claim 313 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

326. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;

counting and determining the denomination of the bills including bills of a plurality of denominations utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

determining the face orientation of the bills;

routing bills having a target denomination and a target face orientation to one of the first output receptacles,

routing bills having the target denomination and a face orientation opposite the target face to a second one of the output receptacles; and

presenting bills not having the target denomination in a third one of the output receptacles.

327. The method of claim 326 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

328. The method of claim 326 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

329. The method of claim 326 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

[ 330. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device, the output receptacles include at least a first output receptacle and a second output receptacle;

counting and determining the denomination of the bills including bills of a plurality of denominations utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

monitoring whether any bills are present in the first and second output receptacles;

routing bills having a first target denomination to the first output receptacle;

routing bills having a second target denomination to the second output receptacle;

upon encountering a bill having neither the first target denomination nor the second target denomination; then

- a) stopping the operation of the device if both the first and the second output receptacles have one or more bills therein; or
- b) routing the bill having neither the first target denomination nor the second target denomination to an empty one of the first and second output receptacles if one of the output receptacles is empty and resetting the first target denomination to be the denomination of the bill if the bill is routed to the first output receptacle and resetting the second target denomination to be the denomination of the bill if the bill is routed to the second output receptacle.

331. The method of claim 330 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

332. The method of claim 330 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

333. The method of claim 330 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

334. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device, the two output receptacles having at least a first output receptacle and a second output receptacle;

counting and determining the denomination of the bills including bills of a plurality of denominations utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

monitoring whether any bills are present in the first and second output receptacles;

routing bills having a first target denomination to the first output receptacle;

generating a denomination change error upon first encountering a bill not having the first target denomination;

designating a second target denomination to be the denomination of the bill causing generating the first denomination change error upon the first occurrence of a denomination change error,

routing bills having a second target denomination to the second output receptacle;

upon encountering a bill having neither the first target denomination nor the second target denomination, then generating a denomination change error and

- a) stopping the operation of the device if both the first and the second output receptacles have one or more bills therein; or
- b) routing the bill having neither the first target denomination nor the second target denomination to an empty one of the first and second output receptacles if one of the output receptacles is empty and resetting the first target denomination to be the denomination of the bill if the bill is routed to the first output receptacle and resetting the second target denomination to be the denomination of the bill if the bill is routed to the second output receptacle.

335. The method of claim 334 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

336. The method of claim 334 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

337. The method of claim 334 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

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**CLAIMS AFTER ENTRY OF FEBRUARY 19, 2002 AMENDMENT (CLEAN VERSION)**

164. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;  
transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;  
counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;  
determining whether the bills meet or fail to meet a non-piece count related criterion;  
halting the transporting when a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill; and  
wherein the halting is performed such that the flagged bill is positioned as the last bill in one of the output receptacles.

165. The method of claim 164 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

166. The method of claim 164 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

167. The method of claim 164 further including receiving denominated bills of more than one denomination in at least one output receptacle.

168. The method of claim 164 wherein the halting occurs when the denomination of a bill is not determined, a bill whose denomination is not determined being termed a no call bill, and wherein the halting of the no call bill is positioned at an identifiable location in one of the output receptacles.

169. The method of claim 164 wherein bills whose denomination are determined are delivered to a first set of one or more of the output receptacles and wherein bills whose denomination are not determined are directed to a second set of one or more of the output receptacles, a bill whose denomination is not determined being termed a no call bill, the output receptacles of the second set being different from the output receptacles of the first set.

170. The method of claim 169 wherein the second set of output receptacles includes a receptacle designated as a no call output receptacle.

171. The method of claim 170 wherein the halting occurs after a no call bill has been delivered to the no call output receptacle.

172. The method of claim 171 wherein the halting occurs with the no call bill being positioned at an identifiable location in the no call output receptacle.

173. The method of claim 172 wherein the halting occurs with the no call bill being the last bill transported to the no call output receptacle, wherein the criteria is the denomination of a bill and wherein a bill failing to meet the criterion of having its denomination determined is a flagged bill.

174. The method of claim 170 wherein the halting occurs before a no call bill has been delivered to the no call output receptacle.

175. The method of claim 174 wherein the halting occurs with the no call bill being located at an identifiable location within the transport path.

176. The method of claim 169 wherein the halting occurs after the no call bill has been delivered to an output receptacle of the second set.

177. The method of claim 175 wherein the halting occurs with the no call bill being positioned at an identifiable location in an output receptacle of the second set.

178. The method of claim 164 further including determining whether a bill is a stranger bill, wherein a bill failing to have its denomination determined is termed a no call bill, and further including delivering stranger bills to a first set of one or more of the output receptacles and delivering no call bills to a second set of one or more output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

179. The method of claim 164 further including determining whether a bill is a stranger bill and wherein the non-piece count related criterion is a bill being a stranger bill.

180. The method of claim 164 further including determining whether a bill is suspect, a bill determined to be suspect being termed a suspect bill.

181. The method of claim 180 wherein bills whose denomination have been determined are delivered to a first set of one or more of the output receptacles and wherein suspect bills are directed to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

182. The method of claim 179 wherein the second set of output receptacles includes a receptacle designated as a suspect output receptacle.

183. The method of claim 182 wherein the halting occurs before a suspect bill has been delivered to the suspect output receptacle.

184. The method of claim 183 wherein the halting occurs with the suspect bill being located at an identifiable location within the transport path.

185. The method of claim 181 wherein the halting occurs after a suspect bill has been delivered to the suspect output receptacle.

186. The method of claim 185 wherein the halting occurs with the suspect bill being positioned at an identifiable location in the suspect output receptacle.

187. The method of claim 186 wherein the halting occurs with the suspect bill being the last bill transported to the suspect output receptacle, and wherein the non-piece count criterion is a bill being suspect.

188. The method of claim 164 wherein the criterion is the denomination of the bill, a bill failing to have its denomination determined being termed a no call bill, and wherein the halting occurs with a no call bill as the last bill in a second set of one or more of the output receptacles.

189. The method of claim 164 wherein the criterion is a bill being a stranger bill, and wherein the halting occurs with a stranger bill as the last bill in a second set of one or more of the output receptacles.

190. The method of claim 164 wherein the criterion is a bill being a suspect bill, and wherein the halting occurs with a suspect bill as the last bill in a second set of one or more of the output receptacles.

191. The method of claim 164 wherein a bill failing to have its denomination determined being termed a no call bill, and further determining whether a bill is a suspect bill.

192. The method of claim 191 wherein the halting occurs when a bill is determined to be a suspect bill.

193. The method of claim 192 further including delivering bills whose denomination have been determined and suspect bills to a first set of one or more of the output receptacles and delivering no call bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

194. The method of claim 191 wherein the second set of output receptacles consists of a single output receptacle.

195. The method of claim 193 further including determining whether bills are stranger bills, and delivering stranger bills to an output receptacle of the second set.

196. The method of claim 195 wherein the halting occurs after a no call bill or a stranger bill has been delivered to an output receptacle of the second set.

197. The method of claim 196 wherein the halting occurs with the no call bill or the stranger bill being the last bill transported to an output receptacle of the second set.

198. The method of claim 195 wherein the halting does not occur after a no call bill or a stranger bill has been delivered to an output receptacle of the second set.

199. The method of claim 198 wherein the halting occurs after a suspect bill has been delivered to an output receptacle of the first set.

200. The method of claim 191 further including delivering bills whose denomination have been determined to a first set of one or more of the output receptacles and delivering no call bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

201. The method of claim 200 wherein the halting occurs after a no call bill has been delivered to an output receptacle of the second set.

202. The method of claim 164 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

203. The method of claim 164 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

204. A method of evaluating a stack of currency bills and using the currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device along a transport path;

providing a detector in the currency evaluation device that is positioned along the transport path between the input receptacle and the output receptacles, the detector being adapted to generate an output signal;

counting and determining the denomination of the bills with the use of the output signal;

determining whether the bills meet or fail to meet a non-piece count related criterion;

halting the transporting when a bill meets or fails to meet the criterion, a bill meeting or failing to meet the criterion being termed a flagged bill; and

wherein the halting is performed such that a flagged bill is positioned as the last bill in one of the output receptacles.

205. The method of claim 204 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

206. The method of claim 204 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

207. The method of claim 204 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

208. The method of claim 204 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

209. A method of evaluating a stack of currency bills and using the currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device along a transport path;

counting and determining the denomination of the bills utilizing a detector positioned along the transport path between the input receptacle and the output receptacles;

flagging a bill meeting or failing to meet any of a plurality of non-piece count related criteria;

wherein the flagging comprises halting the transporting of the bills in response to a determination that a bill meets or fails to meet at least one of the criteria, the at least one criteria

being termed a halting criterion, a bill meeting or failing to meet any of the criteria being termed a flagged bill; and

wherein the halting occurs with a bill satisfying the halting criteria being positioned as the last bill in one of the output receptacles.

210. The method of claim 209 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

211. The method of claim 209 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

212. The method of claim 209 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

213. The method of claim 209 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

214. A method of evaluating a stack of currency bills using a compact, high-speed United States currency evaluation device comprising:

receiving a stack of United States currency bills of a plurality of denominations in an input receptacle of the currency evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device at a rate of at least 800 bills per minute;



counting and determining the denomination of the bills including United States bills of a plurality of denominations at a rate of at least 800 bills per minute utilizing a detector positioned along a transport path between the input receptacle and the output receptacles; and

flagging bills that meet or fail to meet any of certain non-piece count related criteria, a bill meeting or failing to meet any of the criteria being termed a flagged bill; and

wherein the flagging comprises halting the transporting when a bill meets or fails to meet at least one of the criteria.

215. The method of claim 214 further including receiving denominated bills of more than one denomination in at least one output receptacle.

216. The method of claim 214 further including receiving denominated bills of more than one denomination in only one output receptacle.

217. The method of claim 214 wherein the halting occurs with a bill satisfying at least one criteria being positioned as the last bill in one of the output receptacles.

218. The method of claim 214 wherein one of the certain criteria is the denomination of a bill, a bill failing to meet the criterion of having its denomination determined being termed a no call bill, and wherein no call bills are flagged.

219. The method of claim 218 further including determining whether a bill is a stranger bill, wherein one of the certain criteria is a bill being a stranger bill and wherein stranger bills are flagged.

220. The method of claim 219 further including determining whether a bill is a suspect bill, wherein one of the certain criteria is a bill being a suspect bill and wherein suspect bills are flagged.

221. The method of claim 220 further directing stranger bills and no call bills to a first set of one or more of the output receptacles and directing suspect bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

222. The method of claim 221 wherein the first set of output receptacles includes at least two output receptacles.

223. The method of claim 221 wherein halting occurs when a no call bill or a stranger bill is delivered to an output receptacle of the first set.

224. The method of claim 221 wherein halting does not occur when a no call bill or a stranger bill is delivered to an output receptacle of the first set.

225. The method of claim 214 further including determining whether a bill is a stranger bill and wherein one of the certain criteria is a bill being a stranger bill, and wherein stranger bills are flagged.

226. The method of claim 214 further including determining whether a bill is a suspect bill, wherein one of the certain criteria is a bill being a suspect bill and wherein suspect bills are flagged.

227. The method of claim 214 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

228. The method of claim 214 wherein the halting occurs with a bill that meets or fails to meet the at least one criterion being positioned at an identifiable location in one of the output receptacles.

229. The method of claim 214 wherein the halting occurs with a bill that meets or fails to meet the at least one criterion being positioned at an identifiable location in the transport path.

230. The method of claim 214 wherein the halting occurs with a bill meeting or failing to meet the at least one criterion being located at a predetermined position.

231. The method of claim 214 wherein one of the certain criteria include the denomination of a bill and wherein the halting occurs when a bill fails to meet a criterion of having its denomination determined, a bill failing to meet the criterion of having its denomination determined being termed a no call bill.

232. The method of claim 231 wherein the halting occurs with a no call bill being positioned at an identifiable location in one of the output receptacles.

233. The method of claim 231 wherein the halting occurs with a no call bill being located at a predetermined position.

234. The method of claim 231 further including delivering bills meeting the certain criteria of having their denomination determined to a first set of one or more of the output receptacles and directing no call bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

235. The method of claim 234 wherein the halting occurs before a no call bill has been delivered to an output receptacle of the second set.

236. The method of claim 234 wherein the halting occurs after a no call bill has been delivered to an output receptacle of the second set.

237. The method of claim 236 wherein the halting occurs with a no call bill being positioned at an identifiable location in an output receptacle of the second set.

238. The method of claim 237 wherein the halting occurs with a no call bill being the last bill transported to an output receptacle of the second set.

239. The method of claim 214 further including determining whether bills are suspect bills and wherein the halting occurs when a bill meets a criterion of being determined to be a suspect bill.

240. The method of claim 239 further including delivering bills whose denominations have been determined to a first set of one or more of the output receptacles and delivering suspect bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

241. The method of claim 240 wherein the halting occurs after a suspect bill has been delivered to an output receptacle of the second set.

242. The method of claim 241 wherein the halting occurs with a suspect bill being positioned at an identifiable location in an output receptacle of the second set.

243. The method of claim 242 wherein the halting occurs with the suspect bill being the last bill transported to an output receptacle of the second set.

244. The method of claim 240 further including delivering bills whose denomination have not been determined to an output receptacle of the second set.

245. The method of claim 244 further including directing bills whose denomination have not been determined by the discriminating unit and the suspect bills to different output receptacles of the second set.

246. The method of claim 244 wherein the halting occurs in response to the denomination of a bill not being determined.

247. The method of claim 240 further including delivering bills whose denomination have not been determined to an output receptacle of the first set.

248. The method of claim 240 further including directing the bills whose denomination have been determined and the bills whose denomination have not been determined by the discriminating unit to different output receptacles of the first set.

249. The method of claim 214 wherein the certain criteria include the denomination of a bill and wherein the halting occurs when a bill fails to meet a criterion of having its denomination determined, a bill failing to meet a criterion of having its denomination determination being termed a no call bill, and further including determining whether bills are suspect.

250. The method of claim 249 wherein the halting occurs when a bill meets a second criterion of being determined to be suspect.

251. The method of claim 250 further including delivering bills whose denomination have been determined to a first set of one or more of the output receptacles and directing bills determined to be suspect and bills whose denomination have not been determined to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

252. The method of claim 251 wherein the halting occurs after a no call bill or a suspect bill has been delivered to an output receptacle of the second set.

253. The method of claim 252 wherein the no call bills and suspect bills are delivered to different output receptacles of the second set.

254. The method of claim 252 wherein the halting occurs with the no call bill or the suspect bill being the last bill transported to an output receptacle of the second set.

255. The method of claim 249 further including delivering bills whose denomination have been determined to a first set of one or more of the output receptacles and directing bills whose denomination have not been determined to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

256. The method of claim 255 further including delivering suspect bills to an output receptacle of the second set.

257. The method of claim 255 further including delivering suspect bills to an output receptacle of the first set.

258. The method of claim 214 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

259. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;

counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

flagging a bill when the denomination of the bills is not determined;

wherein the flagging comprises halting the transporting when a bill is flagged; and

delivering bills that have been denominated including bills of a plurality of denominations to a first set of one or more of the output receptacles.

260. The method of claim 259 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

261. The method of claim 259 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

262. The method of claim 259 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

263. The method of claim 259 wherein the halting occurs with the bill whose denomination has not been determined being the last bill transported to one of the output receptacles.

264. The method of claim 259 further including delivering bills that have not been denominated to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

265. The method of claim 264 further including re-stacking denominated bills in an output receptacle of the first set and re-stacking bills which have not been denominated in an output receptacle of the second set.

266. The method of claim 259 wherein the detector includes a stationary optical scanning head, and further including scanning at least a preselected segment of each bill transported between the input and output receptacles along the transport path by the stationary optical scanning head, producing an output signal from the stationary optical scanning head representing the scanned image, and wherein the determining of the denomination of each scanned bill utilizes the output signal.

267. The method of claim 259 wherein the transporting is performed at a rate of at least about 800 bills per minute.

268. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;

counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles; and

determining whether the bills are suspect;

flagging a bill that has been determined to be suspect; and

wherein the flagging comprises halting the transport mechanism when a bill is determined to be suspect.

269. The method of claim 268 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.



270. The method of claim 268 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

271. The method of claim 268 wherein the halting occurs with the suspect bill being the last bill transported to one of the output receptacles.

272. The method of claim 268 wherein the detector includes a stationary optical scanning head and further including scanning at least a preselected segment of each bill transported between the input and output receptacles, producing an output signal representing the scanned image, and wherein the determining of the denomination of each scanned bill utilizes the output signal.

273. A method of evaluating a stack of currency bills using a high-speed United States currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the currency evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device at a rate of at least 800 bills per minute, at least one of the output receptacles being adapted to receive more than one denomination of bills;

counting and determining the denomination of the bills including United States bills of a plurality of denominations at a rate of at least 800 bills per minute, utilizing a detector positioned along a transport path between the input receptacle and the output receptacles; and

flagging bills that meet or fail to meet any of certain non-piece count related criteria, a bill meeting or failing to meet any of the criteria being termed a flagged bill; and

wherein the flagging comprises halting the transporting with a flagged bill that meets or fails to meet at least a given set of the criteria positioned in one of the output receptacles.

274. The method of claim 273 wherein the halting occurs with a flagged bill being positioned as the last bill in one of the output receptacles.

275. The method of claim 273 wherein the halting occurs with a flagged bill being located at a predetermined position.

276. The method of claim 273 wherein the certain criteria include the denomination of a bill, a bill failing to meet a criterion of having its denomination determined being termed a no call bill.

277. The method of claim 276 further including determining whether a bill is a stranger bill and wherein the certain criteria include a bill being a stranger bill.

278. The method of claim 277 further including delivering no call bills to a first set of one or more of the output receptacles and delivering stranger bills to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

279. The method of claim 277 further including determining whether a bill is a suspect bill and wherein the certain criteria include a bill being a suspect bill.

280. The method of claim 279 wherein no calls bills are delivered to a first output receptacle, wherein stranger bills are delivered to a second output receptacle, and wherein the suspect bills are delivered to a third output receptacle.

281. The method of claim 279 wherein the output receptacles include a third output receptacle and further including directing no call bills and stranger bills to the third output receptacle and directing suspect bills to a second output receptacle.

282. The method of claim 281 wherein the halting occurs when a bill is directed to the third output receptacle.

283. The method of claim 281 wherein the halting does not occur when a bill is directed to the third output receptacle.

284. The method of claim 273 wherein the output receptacles include a third output receptacle and further including delivering flagged bills to the second output receptacle.

285. The method of claim 273 further including determining whether a bill is a stranger bill and wherein the certain criteria include a bill being a stranger bill.

286. The method of claim 273 further including determining whether a bill is a suspect bill and wherein the certain criteria include a bill being a suspect bill.

287. The method of claim 273 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

288. The method of claim 273 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

289. The method of claim 273 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

290. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device along a transport path;  
counting and determining the denomination of the bills, utilizing at least one detector positioned along a transport path between the input receptacle and the output receptacles;  
generating a characteristic information output signal in response to detected characteristic information via the detector;  
electronically coupling the characteristic information output signal;  
receiving the characteristic information output signal;  
generating a denomination signal in response to the information output signal;  
producing tracking signals in response to the physical movement of the bills;  
generating a no call signal when the denomination of a bill is not determined;  
generating a stopping signal in response to the no call signal;  
stopping a transport drive motor in response to the stopping signal; and  
directing the bills which have been denominated to a first set of one or more of the output receptacles.

291. The method of claim 290 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

292. The method of claim 290 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

293. The method of claim 290 wherein the stopping occurs with the bill whose denomination has not been determined being the last bill transported to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

294. The method of claim 290 further including directing bills which have not been denominated to a second set of one or more of the output receptacles, the output receptacles of the second set being different from the output receptacles of the first set.

295. The method of claim 294 further including re-stacking denominated bills in one of the first set of output receptacles and re-stacking bills which have not been denominated in one of the second set of the output receptacles.

296. The method of claim 290 further including generating a scanned pattern from each of the bills based on the characteristic information output signal, determining the denomination of a bill by comparing the scanned pattern generated from the bill with master patterns associated with different denominations of bills, and storing the master patterns.

297. The method of claim 296 wherein the detector comprises an optical scanhead and wherein the scanned and master patterns comprise optical patterns.

298. The method of claim 297 further including correlating the scanned pattern generated from the bill with master patterns associated with different denominations of bills and determining the denomination of the bill if the scanned pattern sufficiently correlates with one of the master patterns.

299. The method of claim 290 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

300. The method of claim 290 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images

defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

301. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

- receiving a stack of bills in an input receptacle of the evaluation device;
- transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;
- counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;
- generating a characteristic information output signal in response to detected characteristic information via the detector;
- electronically coupling the characteristic information output signal;
- receiving the characteristic information output signal;
- generating a denomination signal in response to the information output signal;
- generating a suspect signal when a bill is determined to be suspect;
- producing tracking signals in response to the physical movement of the bills;
- generating a stopping signal in response to the suspect signal; and
- stopping a transport drive motor in response to the stopping signal.

302. The method of claim 301 wherein the counting and determining the denomination of the bills comprises counting and determining United States currency bills of a plurality of denominations.

303. The method of claim 301 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

304. The method of claim 301 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

305. The method of claim 301 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

306. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;

counting and determining the denomination of the bills utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

halting the transporting in a predetermined manner in response to a determination that a bill meets a stranger bill criterion and in response to a determination that a bill meets a no call bill criterion; and

wherein a bill which meets the stranger bill criterion is termed a stranger bill, and wherein a bill which meets the no call bill criterion is termed a no call bill.

307. The method of claim 306 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations. -

308. The method of claim 306 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

309. The method of claim 306 wherein the transporting, counting and determining of the currency bills is performed at a rate in excess of 800 bills per minute.

310. The method of claim 306 further including permitting manual removal of a no call or a stranger bill after halting the transporting.

311. The method of claim 310 further comprising restarting the operation of the device via a key after halting the transporting.

312. The method of claim 306 wherein the halting occurs with the bill meeting the stranger bill or non call bill criterion being positioned in one of the output receptacles.

313. The method of claim 306 wherein the halting occurs with the bill meeting the stranger bill or no call bill criterion being positioned as the last bill in one of the output receptacles.

314. The method of claim 306 wherein the halting occurs with the bill meeting the stranger bill or no call bill criterion being located at a predetermined position.

315. The method of claim 306 further including directing denominated currency bills of more than one denomination to at least one of the output receptacles.

316. The method of claim 306 wherein the output receptacles include a second output receptacle, and further including delivering the bills meeting the stranger bill or no call bill criterion to the second output receptacle.

317. The method of claim 306 further including determining whether bills are suspect and wherein one of a criterion is a bill being a suspect bill.



318. The method of claim 317 wherein the output receptacles include second and third output receptacles, and further including delivering stranger and no call bills to the second-output receptacle and wherein suspect bills are delivered to the third output receptacle.

319. The method of claim 318 wherein the halting occurs when a bill meeting the no call criterion or the stranger criterion is delivered to the second output receptacle.

320. The method of claim 306 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, bills of at least two of the denominations having the same dimensions.

321. The method of claim 306 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

322. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;

counting and determining the denomination of the bills including bills of a plurality of denominations utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

routing bills having a target denomination to one of the first output receptacles,

routing bills having any other of the plurality of denominations to a second one of the output receptacles; and

presenting no call bills in a third one of the output receptacles.

323. The method of claim 313 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

324. The method of claim 313 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

325. The method of claim 313 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

326. A method of evaluating a stack of currency bills using a currency evaluation device comprising:

receiving a stack of bills in an input receptacle of the evaluation device;

transporting the bills, one at a time, from the input receptacle to one of two or more output receptacles of the currency evaluation device;

counting and determining the denomination of the bills including bills of a plurality of denominations utilizing a detector positioned along a transport path between the input receptacle and the output receptacles;

determining the face orientation of the bills;

routing bills having a target denomination and a target face orientation to one of the first output receptacles,

routing bills having the target denomination and a face orientation opposite the target face to a second one of the output receptacles; and

presenting bills not having the target denomination in a third one of the output receptacles.

327. The method of claim 326 wherein the counting and determining the denominations of the bills comprising counting and denominating United States currency bills of a plurality of denominations.

328. The method of claim 326 wherein the counting and determining of the currency bills is performed independent of the size of the bills.

329. The method of claim 326 wherein the determining of the denomination of bills includes denominating currency bills of a plurality of denominations, genuine bills of the plurality of denominations having a plurality of images associated therewith, the plurality of images defining the plurality of denominations, and further including scanning the image associated with each of the bills and distinguishing among the plurality of denominations using the scanned image.

Customer No. 30,223

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Robert J. Klein et al.

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Title: METHOD AND APPARATUS  
FOR DOCUMENT PROCESSING

AMENDMENT AND REPLY TO  
OFFICE ACTION MAILED JANUARY 17, 2002

Commissioner for Patents  
Washington, D.C. 20231  
Box Amendment-Fee

CERTIFICATE OF MAILING  
37 C.F.R. § 1.8

I hereby certify that this correspondence is being deposited with the U.S. Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, Washington, D.C. 20231, Box Amendment-Fee, on the date indicated below:

April 15, 2002  
Date

Adrienne White

Dear Commissioner:

This paper is being submitted in reply to the Office Action mailed January 17, 2002, for which the three-month date for response is April 17, 2002. In response to the Office Action mailed January 17, 2002, Applicants respectfully request the Examiner to enter the following amendment and to consider the following remarks.

IN THE CLAIMS:

Please amend claims 157, 168 and 178-180 and add new claims 190-208 as follows.

157. (Twice Amended) A currency evaluation device comprising:  
a discriminating unit adapted to evaluate currency bills, the discriminating unit including a detector, the discriminating unit adapted to determine the denomination of said bills and [and] to detect the occurrence of a plurality of error conditions;

an interface adapted to permit a user of the evaluation device to specify how the plurality of error conditions are to be handled; and

a memory adapted to store user information specifying how the plurality of error conditions are to be handled, the information being capable of subsequent recall and selection by a user of the evaluation device.

168. (Amended) The evaluation device of claim 157 further comprising a transport mechanism adapted to transport the currency bills, one at a time, from an input receptacle past the detector to the plurality of output receptacles, wherein the interface is adapted to permit the user to input information further specifying that upon the occurrence of a particular one of the plurality of error conditions the operation of the evaluation device should be suspended so that a bill triggering the particular error condition is stopped (1) before being delivered into an output receptacle such that the bill is located within the transport mechanism or (2) after being delivered into an output receptacle such that the bill is [present] presented in the at least one output receptacle.

178. (Amended) The [device] method of claim 177 wherein the particular error condition is a no call error condition.

179. (Amended) The [device] method of claim 177 wherein the particular error condition is a suspect document error condition.

180. (Amended) The [device] method of 177 wherein selecting one of the options of the mixed mode of operation further includes selecting one of the options of the mixed mode of operation specifying how to handle a stacker full condition, the options including (1) suspending operation of the device, or (2) directing bills to a non-full one of the plurality of output receptacles.

190. (New) A currency evaluation device comprising:

a discriminating unit for evaluating currency bills, the discriminating unit including a detector, the discriminating unit adapted to determine the denomination of the bills and to detect the occurrence of a plurality of error conditions;

an interface adapted to permit a user of the evaluation device to specify how the plurality of error conditions are to be handled; and

a memory adapted to store user information specifying how the plurality of error conditions are to be handled.

191. (New) The currency evaluation device of claim 190 further comprising a plurality of output receptacles for receiving bills after the bills have been evaluated, the interface permitting the user to specify, for each of the error conditions, to which output receptacle or receptacles a bill triggering a particular error condition is to be directed.

192. (New) The currency evaluation device of claim 190 wherein the interface permits the user to specify, for each of the error conditions, whether the evaluation device should suspend operation.

193. (New) The currency evaluation device of claim 190 wherein the plurality of error conditions comprise a no call error condition.

194. (New) The currency evaluation device of claim 190 wherein the plurality of error conditions comprise a stranger error condition.

195. (New) The currency evaluation device of claim 190 wherein the plurality of error conditions comprise a suspect error condition.

196. (New) The currency evaluation device of claims 190 further comprising a plurality of output receptacles for receiving bills after the bills have been evaluated, the interface permitting the user to specify that upon the occurrence of a particular error condition the operation of the evaluation device should be suspended so that a bill triggering a particular error condition is stopped before being delivered into one of the output receptacles such that the bill is located within a transport mechanism of the evaluation device.

197. (New) The currency evaluation device of claim 196 wherein user information specifies that the bill is to be stopped at a predetermined position within a transport mechanism of the evaluation device.

198. (New) The currency evaluation device of claims 190 further comprising a plurality of output receptacles for receiving bills after the bills have been evaluated, the interface permitting the user to specify that upon the occurrence of a particular error condition the operation of the evaluation device is to be suspended so that a bill triggering a particular error condition is stopped after being delivered into one of the output receptacles.

199. (New) The currency evaluation device of claim 190 wherein the interface permits the user the option of specifying that upon the occurrence of a particular error condition (1) the operation of the evaluation device should be suspended or (2) a bill triggering the particular error condition should be off-sorted to an output receptacle of the evaluation device without suspending the operation of the evaluation device.

200. (New) The currency evaluation device of claim 190 wherein the interface permits the user to specify that upon the occurrence of a particular error condition the operation of the evaluation device should be suspended so that a bill triggering the particular error condition is presented in an output receptacle of the evaluation device.

201. (New) The currency evaluation device of according claim 190 further comprising a plurality of output receptacles for receiving bills after the bills have been evaluated, the interface permitting the user to specify that upon the occurrence of a particular error condition whether the operation of the evaluation device should be suspended so that a bill triggering a particular error condition is stopped (1) before being delivered into one of the output receptacles such that the bill is located within the transport mechanism or (2) after being delivered into one of the output receptacles such that the bill is the last bill delivered into the one output receptacle.

202. (New) The currency evaluation device of claim 190 wherein the plurality of error conditions comprise a denomination change error condition.

203. (New) The currency evaluation device of claim 190 wherein the plurality of error conditions comprise a separate series error condition.

204. (New) The currency evaluation device of claim 190 further comprising exactly two output receptacles for receiving bills after the bills have been evaluated

205. (New) The currency evaluation device of claim 190 wherein the user is permitted to define the name for the stored user information specifying how the plurality of error conditions are to be handled.

206. (New) The currency evaluation device of claim 190 wherein the memory in which the user information specifying how the plurality of error conditions are to be handled is stored is a nonvolatile memory.

207. (New) The currency evaluation device of claim 190 wherein user information specifying how the plurality of error conditions are to be handled stored in memory may be repeatedly recalled including being recallable after power to the currency evaluation device has been switched off and on and being recallable on days subsequent to the day that the user information is originally stored in the memory.

208. (New) The currency evaluation device of claim 190 wherein the user information specifying how the plurality of error conditions are to be handled is stored in memory such that the user information may be repeatedly recalled including being recallable after the device is operated in another mode of operation.

#### **REMARKS**

Claims 157, 168 and 178-180 have been amended. New claims 190-208 have been added. No claims have been canceled. Thus, claims 157, 158 and 164-208 are pending in the present application.

The amendments to claims 157, 168 and 178-180 are to correct obvious typographical errors and do not narrow the scope of these claims.

Attached hereto is a clean version of the claims including changes made to the claims pursuant to the present amendment captioned "Pending Claims After Entry Of Amendment And Reply To Office Action Mailed January 17, 2002."



Applicants reiterate that claims 157, 158 and 164-208 are pending in the present application. The Office Action Summary sheet indicates that only claims 157, 158 and 165-189 are pending. However, it does appear that claim 164 was considered because there are rejections directed to claim 164. In sum, claims 157, 158 and 164-208 are pending in the present application.

Claim Rejection – 35 U.S.C. § 102 (Hashimoto)

Claim 157 has been rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,653,647 to Hashimoto (“Hashimoto”). Applicants respectfully traverse this rejection.

Hashimoto discloses a currency bill sorting and stacking apparatus that operates according to one of seven modes of operation (modes a-g). *See* Hashimoto at col. 5, ll. 4-11. These modes of operation include pre-defined parameters specifying into which of the first, second and third pockets a currency bill is directed. For example, pursuant to a “Two Denominations (e)” mode, bills of a first specified denomination are directed to a first pocket (5), bills of a second specified denomination are directed to a second pocket (6) and bills of unspecified denominations as well as bills whose denomination is unidentifiable are directed to a third pocket (8). *Id.* at col. 5, ll. 42-47. The modes of operation (a)-(g) of the Hashimoto currency bill sorting and stacking apparatus are “factory-defined” modes of operation meaning that they are pre-defined modes of operation stored in a memory of the device. Factory-defined modes are distinguishable from user-defined modes, which enable the user to define a mode of operation that the device will operate pursuant to.

The Hashimoto device is not capable of receiving information from a user specifying how error conditions are to be handled. Rather, the user of the Hashimoto device can select from seven different modes of operation (modes a-g). As is summarized in the Table (bottom of cols. 3-4) of Hashimoto, six of the seven Hashimoto modes (modes a-f) of operation off-sort bills triggering error conditions to a reject pocket (the third pocket 7) and the device continues operating. The seventh Hashimoto mode (mode g) off-sorts bills triggering error conditions to the third pocket and obverse-presented damaged notes of a specified denomination to the second pocket and the device continues operating. A user of the Hashimoto device is only permitted to select a factory-defined mode of operation which specifies the criteria for evaluating currency bills. For example, a user of the Hashimoto

device selecting an operational mode (g) is instructing the device to identify the denomination, orientation (*i.e.*, obverse or reverse) and to determine whether the note is damaged. However, the Hashimoto device is not capable of receiving input from an operator specifying how to handle error conditions for any of its seven modes of operation. Put another way, in the above example, the Hashimoto device does not permit the user selecting operational mode (g) to specify how bills triggering error conditions are handled; pursuant to operational mode (g), bills whose denomination cannot be identified are always off-sorted to the third pocket and obverse-presented damaged notes of the specified denomination are always off-sorted to the second pocket. In sum, Hashimoto does not disclose an interface adapted to permit a user to specify how the error conditions are to be handled.

Claim 157 is directed to a currency evaluation device that includes, *inter alia*, “an interface adapted to permit a user of the evaluation device to specify how the plurality of error conditions are to be handled” and “a memory adapted to store user information specifying how the plurality of error conditions are to be handled, the information being capable of subsequent recall and selection by a user of the evaluation device.” In sum, the currency evaluation device of claim 157 is capable of handling bills triggering error conditions as specified by a user and storing those specifications in a memory of the device (which would obviate the need for the user of the device to re-specify how error conditions are to be handled each time the user desires the machine to operate pursuant in that manner). Examples of such a device are discussed in connection with FIGS. 38-40 beginning at page 71, line 1 of Applicants’ specification.

Hashimoto does not disclose a device capable of receiving input specifying how to handle error conditions and storing that input in a manner capable of subsequent recall and selection. Hashimoto does not disclose that a user can define the manner in which error conditions are handled; rather, the user of Hashimoto’s currency bill sorting and stacking apparatus is limited to seven pre-defined mode of operation (a)-(g). Therefore, Applicants respectfully submits that claim 157 is patentable over Hashimoto under 35 U.S.C. § 102(b) for at least this reason.

Further, Applicants respectfully submit that new claims 190-208 are patentable over Hashimoto. Hashimoto does not disclose a device that permits the user to specify how a plurality of error conditions are handled or a device that stores in memory user information specifying how the plurality of error conditions are to be handled. Thus, Applicants

respectfully submit that new claims 190-208 are patentable over Hashimoto under 35 U.S.C. § 102(b) for at least this reason.

Claim Rejections – 35 U.S.C. § 103 (Hashimoto, Cargill)

Claims 164-189 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Hashimoto in view of U.S. Patent No. 5,430,664 to Cargill et al. (“Cargill”).

Cargill discloses a single-pocket document counting and batching apparatus that evaluates currency bills and is adapted to detect the presence of error conditions including “counterfeit suspect,” “double” and “chain” errors. *See* Cargill at col. 22, ll. 1-13 (Table IV). Error conditions are handled by the Cargill device by halting the motor so that the bill triggering the error condition and the subsequent bill (if any) are delivered to the single pocket. *Id.* at col. 19, ll. 15-25. The operator of the Cargill device then removes the two bills from the single pocket, inspects the counterfeit bill and returns the bill subsequent the error triggering bill (if any) back to the hopper for evaluation. *Id.*

Cargill does not disclose handling error conditions in any other manner than halting the operation of the motor and delivering the bill triggering the error condition and the subsequent bill to the single pocket. Nor does Cargill disclose permitting a user of the Cargill device to specify how the occurrence of error conditions are to be handled. Likewise, as discussed above, Hashimoto does not disclose a device capable of receiving input from a user specifying how to handle the occurrence of error conditions.

Applicants’ claims 164-189 are directed to apparatuses and methods that permit the handling of bills triggering error conditions occurring during the evaluation of currency bills as specified by a user or in a user-defined manner: “an interface adapted to permit a user of the evaluation device to specify how the plurality of error conditions are to be handled” and “a memory adapted to store user information specifying how the plurality of error conditions are to be handled, the information being capable of subsequent recall and selection by a user of the evaluation device” (claim 157); “the memory being designed to store at least one user-defined mode of operation, . . . capable of subsequent recall and selection by a user of the evaluation device” and “an interface adapted to permit a user . . . to define the user-defined mode of operation” (claim 158); “an interface adapted to permit a user to select one of the options of the mixed mode of operation . . . the device being adapted to store a selected option in the memory of the device along with the mixed mode of operation as a user-defined mode of operation in a manner to permit subsequent recall and selection by a user” (claim 174);

“selecting one of the options of the mixed mode of operation via the user interface” and “storing the selected option in the memory of the device along with the mixed mode of operation as a user-defined mode of operation in a manner to permit subsequent recall and selection by a user” (claim 177); “the memory being adapted to store at least one user-defined mode of operation” and “an interface adapted to permit a user of the evaluation device to define the user-defined mode of operation” (claim 181); “defining at least one user-defined mode . . . specifying to which of the plurality of output receptacles a bill meeting or failing to meet one or more criteria is to be transported” and “storing the user-defined mode of operation in the memory” (claim 182); “an interface adapted to permit a user of the evaluation device to define at least one user-defined mode of operation specifying how to operate including how to handle the occurrence of one or more error conditions, the user-defined mode of operation user being stored in the memory” (claim 184); and “defining at least one user-defined mode of operation specifying how to operate including how to handle the occurrence of one or more error conditions” and “storing the user-defined mode of operation in a memory” (claim 188).

The office action alleges it would have been obvious to one of ordinary skill in the art to combine these references to use the “control particulars” of Cargill in the bill sorting device of Hashimoto and that the motivation for doing so would have been “to provide digital control networking capability to ‘coordinate operations of counting and verifying documents.’” Applicants respectfully traverse this allegation. Applicants respectfully submit that there is no teaching or suggestion in these references, alone or in combination, to permit a user to specify how error conditions are to be handled. Both Cargill and Hashimoto teach that the error conditions are handled in a pre-determined (*i.e.*, factory-defined) manner: Cargill discloses halting the motor and delivering the bill triggering the error condition and the subsequent bill to the single pocket; Hashimoto teaches off-sorting a bill triggering an error condition. The “control particulars” of Cargill cited by the office action as the motivation for combining Cargill with Hashimoto are directed to a digital control network for coordinating the operations of counting and verifying documents. The “control particulars” do not allow for operator input specifying how error conditions are to be handled. Rather, Applicants respectfully submit that the combination proposed by the office actions is an improper use of hindsight. *See, e.g., W.L. Gore & Assoc., Inc. v. Garlock, Inc.*, 220 U.S.P.Q. 303, 313 (Fed. Cir. 1983).

Furthermore, even if there was some teaching, suggestion or motivation to combine these references, a device or method that permits a user to specify how bills triggering error conditions are to be handled and that stores those specifications in a memory of the device is not disclosed by Hashimoto, Cargill nor a combination thereof. Therefore, Applicants respectfully submits that claims 164-189 are patentable over Hashimoto in view of Cargill under 35 U.S.C. § 103(a) for at least this reason.

Additionally, Applicants respectfully submit that new claims 190-208 are patentable over the combination of Hashimoto and Cargill. The cited combination does not disclose a device that permits the user to specify how a plurality of error conditions are handled or a device that stores in memory user information specifying how the plurality of error conditions are to be handled. Thus, Applicants respectfully submit that new claims 190-208 are patentable over Hashimoto in view of Cargill under 35 U.S.C. § 103(a) for at least this reason.

Claim Rejections – 35 U.S.C. § 103 (Omatu, Molbak)

Claims 157, 158 and 164-189 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,729,623 to Omatu et al. (“Omatu”) in view of U.S. Patent No. 5,564,546 to Molbak et al. (“Molbak”). Applicants respectfully traverse this rejection.

Omatu is primarily directed to a bill-recognition apparatus having a learning capability and is able to identify currency bills using pattern recognition. Regarding the handling of error conditions, Omatu only mentions that bills that cannot be identified are routed to a reject stacker 106. *See* Omatu at col. 16, ll. 58-61. Omatu does not disclose that occurrences of error conditions can be handled as specified by a user or in a user-defined manner or that the user specifications or user-defined manner can be stored in a memory. Rather, a user of the Omatu device is limited to pre-defined or factory-defined “rejection modes” (“a rejection setting button for setting the rejection mode such as that bills whose types are different from the type of the bill recognized first after the start/stop button 122 has been processed will be rejected”) for specifying criteria for rejecting bills – not for specifying how to handle bills failing to meet that criteria. *Id.* at col. 8, ll. 7-10. Omatu only discloses that rejected bills are directed to the reject stacker 106. *Id.* at col. 8, l. 25 and col. 16, ll. 58-61.

Molbak discloses a coin counting machine that issues a redeemable voucher for an amount related to the amount of deposited coins. Molbak does not disclose the processing of currency bills. Citing FIGS. 2, 4 and 5 of Molbak, the office action alleges that Molbak

discloses “particulars of operator interface and allowing error detection and operator control (operator intervention).” These figures of Molbak disclose nothing in the way of operator intervention with respect to error conditions. The only “operator intervention” disclosed by Molbak is in the form of input regarding whether to accept the determined amount of deposited coins, whether to reject the amount so that the coins are returned to the user or whether to donate the processed coins to charity.

Applicants respectfully submit that the system of Molbak relates to the processing of bulk coins and dispensing a redeemable voucher and is non-analogous art and may not be properly combined with Omatu in rejecting Applicants’ claims 157, 158 and 164-189. First, Molbak relates to coin processing, whereas Applicants’ claims are directed to the processing of currency bills. Second, the user input received in Molbak is regarding whether to accept or reject a transaction where, for example, the user disagrees with the determined amount of processed coins or where the user desires to donate the processed coins to charity. This “operator intervention” disclosed by Molbak (*e.g.*, rejecting the determined amount, donating coins to charity) is fundamentally different than user-input specifying how the occurrences of error conditions are to be handled. As such, Applicants respectfully submit that Molbak is non-analogous art and that the rejection of Applicants’ claims based on Molbak is improper.

The office action alleges that “it would have been obvious to one of ordinary skill in the art to have used the operator intervention particulars of Molbak et al in the bill sorting and stacking apparatus of Omatu et al.” Applicants respectfully submit that there is no motivation for the proposed combination of Omatu and Molbak found within the references themselves or within the knowledge of one of ordinary skill in the art at the time the present invention was made. The office action alleges that the motivation for combining Omatu and Molbak would be “to provide user control over the sorting process.” The entire disclosure of Molbak is directed to a coin counting/sorting machine, not currency bill processing. Further, any user control disclosed by Molbak is unrelated to the sorting of coins but is directed to where to apply the proceeds resulting from the coin sorting process. Further, Applicants respectfully submit that one of ordinary skill in the art would be unmotivated to combine Molbak and Omatu because Molbak is non-analogous art.

Even if Molbak was analogous art or if a motivation for combining Molbak and Omatu did exist, the proposed combination does not disclose, teach or suggest Applicants’ claims 157, 158 and 164-189. As discussed above, these claims are directed to apparatuses and methods that permit the handling of bills triggering error conditions occurring during the

evaluation of currency bills a user-specified fashion or a in a user-defined manner. A device or method that permits a user to specify how bills triggering error conditions are to be handled and to store that information as a user-defined mode of operation in a memory of the device is not disclosed by Omatu, Molbak, nor a combination thereof. Therefore, Applicants respectfully submit that claims 157, 158 and 164-189 are patentable over Omatu in view of Molbak under 35 U.S.C. § 103(a) for at least this reason.

Additionally, Applicants respectfully submit that new claims 190-208 are patentable over the combination of Omatu and Molbak. The cited combination does not disclose a device that permits the user to specify how a plurality of error conditions are handled or a device that stores in memory user information specifying how the plurality of error conditions are to be handled. Thus, Applicants respectfully submit that new claims 190-208 are patentable over Omatu in view of Molbak under 35 U.S.C. § 103(a) for at least this reason.

#### Nonstatutory Double Patenting Rejections

Claims 157, 158 and 164-189 have been rejected under the judicially created doctrine of obvious-type double patenting as being unpatentable over claims 1-56 of U.S. Patent No. 6,311,819 B1 to Stromme et al.

The present application is continued from U.S. Patent Application Serial No. 08,864,423, which issued as U.S. Patent No. 6,311,819 B1. Thus, Applicants are filing a terminal disclaimer with respect to U.S. Patent No. 6,311,819 B1 herewith to obviate this obviousness-type double patenting rejection.

#### Conclusion

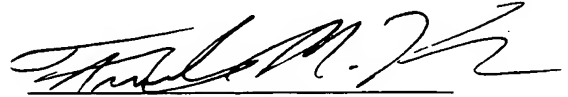
In conclusion, Applicants respectfully submit that in view of the amendments and remarks set forth herein, that all rejections have been overcome and that all claims are in condition for allowance and such action is earnestly solicited.

If there are any matters which may be resolved or clarified through a telephone interview, the Examiner is respectfully requested to contact Applicants' undersigned attorney at the number indicated.

The Commissioner is authorized to charge Jenkins & Gilchrist Deposit Account No. 10-0447 (Order No. 47171-00272USC1) in the amount of \$426.00, presently due in connection with this Amendment And Reply. If, however, there are additional fees due, the Commissioner is authorized to charge any additional fees which may be required (except

payment of the issue fee) to JENKENS & GILCHRIST, P.C. Deposit Account No. 10-0447(47171-00272USC1).

Respectfully submitted,



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ATTORNEYS FOR APPLICANTS

Date: April 15, 2002



**PENDING CLAIMS AFTER ENTRY OF AMENDMENT  
AND REPLY TO OFFICE ACTION MAILED JANUARY 17, 2002**

157. (Twice Amended) A currency evaluation device comprising:
- a discriminating unit adapted to evaluate currency bills, the discriminating unit including a detector, the discriminating unit adapted to determine the denomination of said bills and to detect the occurrence of a plurality of error conditions;
  - an interface adapted to permit a user of the evaluation device to specify how the plurality of error conditions are to be handled; and
  - a memory adapted to store user information specifying how the plurality of error conditions are to be handled, the information being capable of subsequent recall and selection by a user of the evaluation device.
158. (Twice Amended) A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:
- an input receptacle adapted to receive a stack of bills to be evaluated;
  - a plurality of output receptacles adapted to receive bills after evaluation;
  - a transport mechanism adapted to transport bills, one at a time, from the input receptacle to the plurality of output receptacles along a transport path;
  - a discriminating unit adapted to evaluate the bills, the discriminating unit including a detector positioned along the transport path between the input receptacle and the output receptacle, the discriminating unit adapted to determine the denomination of the bills and to detect the occurrence of a plurality of error conditions;
  - a memory adapted to store information associated with a plurality of modes of operation of the device, the memory being designed to store at least one user-defined mode of operation, the user-defined mode of operation being capable of subsequent recall and selection by a user of the evaluation device;
  - an interface adapted to permit a user of the evaluation device to define the user-defined mode of operation, the interface receiving information from the user specifying how the device is to operate including how the plurality of error conditions are to be handled, the information being stored in the memory; and
  - a mode selection element permitting the user to select one of the modes of operation.

164. The evaluation device of claim 157 further comprising a transport mechanism adapted to transport the currency bills from an input receptacle, one at a time, past the detector, to the plurality of output receptacles, wherein the interface is adapted to permit the user to input information further specifying that the operation of the evaluation device should be suspended so that a bill triggering a particular one of a plurality of error conditions is stopped before being delivered into one of the plurality of output receptacle such that the bill is located within the transport mechanism.

165. The evaluation device of 157 further comprising a transport mechanism adapted to transport the currency bills from an input receptacle, one at a time, past the detector, to the plurality of output receptacles, wherein the interface is adapted to permit the user to input information further specifying that upon the occurrence of a particular one of the plurality of error conditions (1) the operation of the evaluation device should be suspended or (2) a bill triggering the particular error condition should be off-sorted to one of the plurality of output receptacles without suspending operation of the evaluation device.

166. The evaluation device of claim 165 wherein the interface is adapted to permit the user to input information further specifying that the operation of the evaluation device should be suspended so that a bill triggering the particular error condition is presented in one of the plurality of output receptacles.

167. The evaluation device of claim 165 wherein the interface is adapted to permit the user to input information further specifying that upon the occurrence of the particular error condition the operation of the evaluation device should be suspended so that a bill triggering the particular error condition is stopped before being delivered into one of the plurality of output receptacles such that the bill is located within a transport mechanism of the evaluation device.

168. (Amended) The evaluation device of claim 157 further comprising a transport mechanism adapted to transport the currency bills, one at a time, from an input receptacle past the detector to the plurality of output receptacles, wherein the interface is adapted to permit the user to input information further specifying that upon the occurrence of a particular one of the plurality of error conditions the operation of the evaluation device should be suspended so

that a bill triggering the particular error condition is stopped (1) before being delivered into an output receptacle such that the bill is located within the transport mechanism or (2) after being delivered into an output receptacle such that the bill is presented in the at least one output receptacle.

169. The evaluation device of claim 158 wherein the interface is adapted to receive information from the user further specifying that the operation of the evaluation device should be suspended so that a bill triggering one of a plurality of error conditions is stopped before being delivered into the at least one output receptacle such that the bill is located within the transport mechanism.

170. The evaluation device of 158 wherein the at least one output receptacle is a plurality of output receptacles, and wherein the interface is adapted to permit the user to input information further specifying that upon the occurrence of a particular one of the plurality of error conditions (1) the operation of the evaluation device should be suspended or (2) a bill triggering the particular error condition should be off-sorted to an output receptacle without suspending operation of the evaluation device.

171. The evaluation device of claim 170 wherein the interface is adapted to permit a user to input information further specifying that upon the occurrence of the particular error condition the operation of the evaluation device should be suspended so that a bill triggering the particular error condition is presented in one of the plurality of output receptacles.

172. The evaluation device of claim 170 wherein the interface is adapted to permit the user to input information further specifying that upon the occurrence of the particular error condition the operation of the evaluation device should be suspended so that a bill triggering the particular error condition is stopped before being delivered to the plurality of output receptacles such that the bill is located within the transport mechanism.

173. The evaluation device of claim 158 wherein the interface is adapted to permit the user to input information further specifying that upon the occurrence of a particular one of the plurality of error conditions whether the operation of the evaluation device should be suspended so that a bill triggering the particular error condition is stopped (1) before being

delivered to the at least one output receptacle such that the bill is located within the transport mechanism or (2) after being delivered into the at least one output receptacle such that the bill is presented in the at least one output receptacle such that the bill is presented in the at least one output receptacle.

174. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device having a plurality of pre-defined modes of operation stored in a memory of the device, each of the plurality of pre-defined modes instructing the device how to operate, the plurality of pre-defined modes of operation including a mixed mode of operation, the mixed mode of operation being adapted to instruct the device to determine the aggregate value of a stack of bills having two or more denominations of bills, the mixed mode of operation including one or more options specifying how to handle the occurrence of one or more error conditions, the device comprising:

- an input receptacle adapted to receive a stack of bills to be evaluated;

- a plurality of output receptacles each adapted to receive bills after evaluation;

- a transport mechanism adapted to transport bills, one at a time, from the input receptacle along a transport path to the plurality of output receptacles;

- an evaluation unit disposed along the transport path, the evaluation unit adapted to determine information concerning each of the bills including the denomination of each of the bills, the evaluation unit being adapted to detect one or more error conditions;

- an interface adapted to permit a user to select one of the options of the mixed mode of operation, the plurality of options including designating that a bill triggering a particular error condition is to be (1) presented in a first one of the plurality of output receptacles such that the operation of the transport mechanism is suspended, (2) presented in a second one of the plurality of output receptacles such that the operation of the transport mechanism is suspended, or (3) off-sorted into the second one of the plurality of output receptacles such that the transport mechanism continues operation, the device being adapted to store a selected option in the memory of the device along with the mixed mode of operation as a user-defined mode of operation in a manner to permit subsequent recall and selection by a user; and

- a mode selection element permitting the user to select a mode of operation selected from the group comprising the user-defined mode and the plurality of pre-defined modes including the mixed mode, wherein selection of the user-defined mode automatically recalls the selected option from memory.

175. The device of claim 174 wherein the particular error condition is a no call error condition.

176. The device of claim 174 wherein the particular error condition is a suspect document error condition.

177. A method of evaluating currency bills with a currency evaluation device, the device including a transport mechanism adapted to transport bills, one at a time, from an input receptacle past an evaluation unit to a plurality of output receptacles, the evaluation unit being adapted to determine the denomination of each of the currency bills and to detect one or more error conditions, the device having a plurality of pre-defined modes of operation stored in a memory of the device, each of the plurality of pre-defined modes of operation instructing the device how to operate, the plurality of modes of operation including a mixed mode of operation, the mixed mode of operation being adapted to instruct the device to determine the aggregate value of a stack of bills having two or more denominations of bills, the mixed mode of operation including one or more options specifying how to handle the occurrence of one or more error conditions, the method comprising:

- selecting the mixed mode of operation, via a user interface, from the plurality of modes of operation;

- selecting one of the options of the mixed mode of operation via the user interface, the one or more options including designating that a bill triggering a particular error condition is to be (1) presented in a first one of the plurality of output receptacles such that the operation of the transport mechanism is suspended, (2) presented in a second one of the plurality of output receptacles such that the operation of the transport mechanism is suspended, or (3) off-sorted into the second one of the plurality of output receptacles such that the transport mechanism continues operation;

- storing the selected option in the memory of the device along with the mixed mode of operation as a user-defined mode of operation in a manner to permit subsequent recall and selection by a user; and

- selecting a mode of operation selected from the group comprising the plurality of pre-defined modes including the mixed mode and the user-defined mode, wherein selection of the user-defined mode automatically recalls the selected option from memory.

178. (Amended) The method of claim 177 wherein the particular error condition is a no call error condition.

179. (Amended) The method of claim 177 wherein the particular error condition is a suspect document error condition.

180. (Amended) The method of 177 wherein selecting one of the options of the mixed mode of operation further includes selecting one of the options of the mixed mode of operation specifying how to handle a stacker full condition, the options including (1) suspending operation of the device, or (2) directing bills to a non-full one of the plurality of output receptacles.

181. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device comprising:

- an input receptacle adapted to receive a stack of bills to be evaluated;

- a plurality of output receptacles adapted to receive bills after evaluation;

- a transport mechanism adapted to transport bills, one at a time, from the input receptacle along a transport path to the plurality of output receptacles;

- an evaluation unit adapted to determine information concerning each of the bills including the denomination of each of the bills, the evaluation unit including a sensor positioned along the transport path, the evaluation unit being adapted to detect one or more error conditions;

- a nonvolatile memory adapted to store information associated with a plurality of pre-defined modes of operation of the device, the memory being adapted to store at least one user-defined mode of operation in a manner such that the at least one user-defined mode of operation is capable of subsequent recall and selection by a user of the evaluation device;

- an interface adapted to permit a user of the evaluation device to define the user-defined mode of operation, the interface being adapted to receive information from the user specifying criteria for evaluating the bills and specifying to which of output receptacles a bill meeting or failing to meet one or more criteria is to be transported, the information being stored in the nonvolatile memory as a user-defined mode of operation; and

a mode selection element adapted to permit the user to select a mode of operation selected from the group consisting of the plurality of pre-defined mode of operation and the at least one user defined mode of operation.

182. A method of evaluating currency bills with a currency evaluation device, the device including a transport mechanism adapted to transport bills, one at a time, from an input receptacle past an evaluation unit to a plurality of output receptacles, the evaluation unit being adapted to determine the denomination of each of the currency bills and to detect one or more error conditions, the device having a plurality of pre-defined modes of operation stored in a memory of the device, each of the plurality of modes of operation instructing the device how to operate, the method comprising:

- defining at least one user-defined mode of operation including specifying criteria for evaluating the bills and specifying to which of the plurality of output receptacles a bill meeting or failing to meet one or more criteria is to be transported;

- storing the user-defined mode of operation in the memory of the device in a manner to permit subsequent recall and selection of the user-defined mode of operation by the user of the evaluation device;

- permitting a user to select the user-defined mode of operation stored in the memory of the device; and

- transporting bills meeting one or more criteria to one of the plurality of output receptacle according to the user-defined mode of operation; and

- transporting bills failing to meet one or more criteria to one of the plurality of output receptacle according to the user-defined mode of operation.

183. The method of claim 182 further comprising:

- subsequently selecting the user-defined mode of operation;

- recalling from the memory the user-defined mode of operation;

- transporting bills meeting one or more criteria to one of the plurality of output receptacle according to the user-defined mode of operation; and

- transporting bills failing to meet one or more criteria to one of the plurality of output receptacle according to the user-defined mode of operation.

184. A currency evaluation device for receiving a stack of currency bills and rapidly evaluating all the bills in the stack, the device having a plurality of pre-defined modes of operation stored in a memory of the device, each of the plurality of pre-defined modes of operation instructing the device how to operate, the device comprising:

- an input receptacle adapted to receive a stack of bills to be evaluated;
- a plurality of output receptacle adapted to receive bills after evaluation;
- a transport mechanism adapted to transport bills, one at a time, from the input receptacle along a transport path to the at least one output receptacle;
- an evaluation unit disposed along the transport path, the evaluation unit adapted to determine information concerning each of the bills including the denomination of each of the bills, the evaluation unit being adapted to detect one or more error conditions;
- an interface adapted to permit a user of the evaluation device to define at least one user-defined mode of operation specifying how to operate including how to handle the occurrence of one or more error conditions, the user-defined mode of operation user being stored in the memory of the device in a manner to permit subsequent recall and selection by a user; and
- a mode selection element permitting the user to select a mode of operation selected from the group comprising the plurality of pre-defined modes of operation and the a least one user-define mode of operation.

185. The currency evaluation device of claim 184 wherein the interface is adapted to permit a user to define a user-defined mode of operation specifying that a bill triggering a particular error condition is to be presented in a first one of the plurality of output receptacles such that the operation of the transport mechanism is suspended.

186. The currency evaluation device of claim 184 wherein the interface is adapted to permit a user to define a user-defined mode of operation specifying that a bill triggering a particular error condition is to be presented in a second one of the plurality of output receptacles such that the operation of the transport mechanism is suspended.

187. The currency evaluation device of claim 184 wherein the interface is adapted to permit a user to define a user-defined mode of operation specifying that a bill triggering a particular



error condition is to be off-sorted into the second one of the plurality of output receptacles such that the transport mechanism continues operation.

188. A method of evaluating currency bills with a currency evaluation device, the device including a transport mechanism adapted to transport bills, one at a time, from an input receptacle past an evaluation unit to a plurality of output receptacles, the evaluation unit being adapted to determine the denomination of each of the currency bills and to detect one or more error conditions, the device having a plurality of pre-defined modes of operation, each of the plurality of pre-defined modes of operation instructing the device how to operate, the method comprising:

- defining at least one user-defined mode of operation specifying how to operate including how to handle the occurrence of one or more error conditions;

- storing the user-defined mode of operation in a memory of the device in a manner to permit subsequent recall and selection by a user of the device;

- permitting a user to select the user-defined mode of operation stored in the memory of the device; and

- handling the occurrence of one or more error conditions according to the user-defined mode of operation when the user-defined mode of operation has been selected.

189. The method of claim 188 further comprising:

- subsequently selecting the user-defined mode of operation;

- recalling from the memory the user-defined mode of operation; and

- handling the occurrence of one or more error conditions according to the user-defined mode of operation.

190. (New) A currency evaluation device comprising:

- a discriminating unit for evaluating currency bills, the discriminating unit including a detector, the discriminating unit adapted to determine the denomination of the bills and to detect the occurrence of a plurality of error conditions;

- an interface adapted to permit a user of the evaluation device to specify how the plurality of error conditions are to be handled; and

- a memory adapted to store user information specifying how the plurality of error conditions are to be handled.

191. (New) The currency evaluation device of claim 190 further comprising a plurality of output receptacles for receiving bills after the bills have been evaluated, the interface permitting the user to specify, for each of the error conditions, to which output receptacle or receptacles a bill triggering a particular error condition is to be directed.

192. (New) The currency evaluation device of claim 190 wherein the interface permits the user to specify, for each of the error conditions, whether the evaluation device should suspend operation.

193. (New) The currency evaluation device of claim 190 wherein the plurality of error conditions comprise a no call error condition.

194. (New) The currency evaluation device of claim 190 wherein the plurality of error conditions comprise a stranger error condition.

195. (New) The currency evaluation device of claim 190 wherein the plurality of error conditions comprise a suspect error condition.

196. (New) The currency evaluation device of claims 190 further comprising a plurality of output receptacles for receiving bills after the bills have been evaluated, the interface permitting the user to specify that upon the occurrence of a particular error condition the operation of the evaluation device should be suspended so that a bill triggering a particular error condition is stopped before being delivered into one of the output receptacles such that the bill is located within a transport mechanism of the evaluation device.

197. (New) The currency evaluation device of claim 196 wherein user information specifies that the bill is to be stopped at a predetermined position within a transport mechanism of the evaluation device.

198. (New) The currency evaluation device of claims 190 further comprising a plurality of output receptacles for receiving bills after the bills have been evaluated, the interface permitting the user to specify that upon the occurrence of a particular error condition the

operation of the evaluation device is to be suspended so that a bill triggering a particular error condition is stopped after being delivered into one of the output receptacles.

199. (New) The currency evaluation device of claim 190 wherein the interface permits the user the option of specifying that upon the occurrence of a particular error condition (1) the operation of the evaluation device should be suspended or (2) a bill triggering the particular error condition should be off-sorted to an output receptacle of the evaluation device without suspending the operation of the evaluation device.

200. (New) The currency evaluation device of claim 190 wherein the interface permits the user to specify that upon the occurrence of a particular error condition the operation of the evaluation device should be suspended so that a bill triggering the particular error condition is presented in an output receptacle of the evaluation device.

201. (New) The currency evaluation device of according claim 190 further comprising a plurality of output receptacles for receiving bills after the bills have been evaluated, the interface permitting the user to specify that upon the occurrence of a particular error condition whether the operation of the evaluation device should be suspended so that a bill triggering a particular error condition is stopped (1) before being delivered into one of the output receptacles such that the bill is located within the transport mechanism or (2) after being delivered into one of the output receptacles such that the bill is the last bill delivered into the one output receptacle.

202. (New) The currency evaluation device of claim 190 wherein the plurality of error conditions comprise a denomination change error condition.

203. (New) The currency evaluation device of claim 190 wherein the plurality of error conditions comprise a separate series error condition.

204. (New) The currency evaluation device of claim 190 further comprising exactly two output receptacles for receiving bills after the bills have been evaluated

205. (New) The currency evaluation device of claim 190 wherein the user is permitted to define the name for the stored user information specifying how the plurality of error conditions are to be handled.

206. (New) The currency evaluation device of claim 190 wherein the memory in which the user information specifying how the plurality of error conditions are to be handled is stored is a nonvolatile memory.

207. (New) The currency evaluation device of claim 190 wherein user information specifying how the plurality of error conditions are to be handled stored in memory may be repeatedly recalled including being recallable after power to the currency evaluation device has been switched off and on and being recallable on days subsequent to the day that the user information is originally stored in the memory.

208. (New) The currency evaluation device of claim 190 wherein the user information specifying how the plurality of error conditions are to be handled is stored in memory such that the user information may be repeatedly recalled including being recallable after the device is operated in another mode of operation.

1. A method of creating identifiable smaller stacks of currency bills within a larger stack of currency bills using a currency evaluation device, the method comprising:
  - (a) receiving a stack of currency bills in an input receptacle;
  - (b) transporting the bills from the input receptacle, one at a time, past an evaluating unit to at least one output receptacle;
  - (c) identifying the face orientation of each of the bills with the evaluating unit; and either
    - (1) maintaining the orientation of a bill when the orientation of the bill matches a target orientation; or
    - (2) reversing the orientation of a bill when the orientation of the bill does not match the target orientation;
  - (d) stacking a predetermined number of bills in the at least one output receptacle, the predetermined number of bills having a common face orientation;
  - (e) redefining the target orientation to be the other of the two face orientations after the predetermined number of bills have been transported to the at least one output receptacle; and
  - (f) repeating (b), (c), (d), and (e), until each of the bills are transported from the input receptacle.
2. The method of claim 1 further comprising determining the authenticity of each of the currency bills.
3. The method of claim 1 further comprising determining the denomination of each of the currency bills.
4. The method of claim 3 further comprising totaling the value of the currency bills transported to the at least one output receptacle.
5. The method of claim 1 wherein the at least one output receptacle comprises a plurality of output receptacles.

6. The method of claim 5 further comprising:  
determining the authenticity of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the authenticity of the bill cannot be determined.

7. The method of claim 5 further comprising:  
determining the denomination of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the denomination of the bill cannot be determined

8. The method of claim 1 further comprising defining an initial target orientation to be the face orientation of a first bill transported from the input receptacle.

9. The method of claim 1 wherein reversing the face orientation of a bill further comprises reversing the face orientation of a bill with a bill facing mechanism.

10. A method of creating identifiable smaller stacks of currency bills within a larger stack of currency bills using a currency evaluation device, the method comprising:

- (a) defining a target orientation to be one of two face orientations, one of the two face orientations being face-down, the other of the two face orientations being face-up;
- (b) receiving a stack of currency bills in an input receptacle;
- (c) transporting each of the bills from the input receptacle, one at a time, past an evaluating unit to at least one output receptacle;
- (d) identifying the face orientation of each of the bills with the evaluating unit; and either
  - (1) maintaining the orientation of the bill when the orientation of the bill matches the target orientation; or
  - (2) reversing the orientation of the bill when the orientation of the bill does not match the target orientation;
- (e) stacking a predetermined number of bills in the at least one output receptacle, the predetermined number of bills having a common face orientation;

(f) redefining the target orientation to be the other of the two face orientations after a predetermined number of bills having been transported to the at least one output receptacle; and

(g) repeating (c), (d), (e), and (f) until each of the bills are transported from the input receptacle.

11. The method of claim 10 further comprising determining the authenticity of each of the currency bills.

12. The method of claim 10 further comprising determining the denomination of each of the currency bills.

13. The method of claim 12 further comprising totaling the value of the currency bills transported to the output receptacle.

14. The method of claim 10 wherein the at least one output receptacle comprises a plurality of output receptacles.

15. The method of claim 14 further comprising:  
determining the authenticity of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the authenticity of the bill cannot be determined.

16. The method of claim 14 further comprising:  
determining the denomination of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the denomination of the bill cannot be determined.

17. The method of claim 10 wherein defining a target orientation further comprises defining the target orientation to be the face orientation of a first bill transported from the input receptacle.

18. The method of claim 10 wherein reversing the orientation of a bill further comprises reversing the face orientation of a bill with a bill facing mechanism.

19. A method of creating identifiable smaller stacks of currency bills within a larger stack of currency bills with a currency evaluation device, the method comprising:

receiving a stack of currency bills in an input receptacle;

transporting each of the bills from the input receptacle, one at a time, past an evaluating unit to at least one output receptacle;

identifying the face orientation of each of the bills with the evaluating unit, the face orientation of the bills being one of two face orientations, one of the two face orientations being face-down, the other of the two face orientations being face-up;

defining a target orientation to be the face orientation of a first bill transported from the input receptacle;

comparing the face orientation of each of the bills with the target orientation;

maintaining the face orientation of a bill when the face orientation of the bill matches the target orientation;

reversing the face orientation of a bill when the face orientation of the bill does not match the target orientation;

stacking a predetermined number of bills in the at least one output receptacle, the predetermined number of bills having a common face orientation;

redefining the target orientation to be the other of the two face orientations after the predetermined number of bills having a common face orientation have been stacked in the at least one output receptacle; and

repeating the above method, beginning with transporting the bills until each of the bills are transported from the input receptacle;

20. The method of claim 19 further comprising determining the authenticity of each of the currency bills.



21. The method of claim 19 further comprising determining the denomination of each of the currency bills.

22. The method of claim 21 further comprising totaling the value of the currency bills transported to the output receptacle.

23. The method of claim 19 wherein the at least one output receptacle comprises a plurality of output receptacles.

24. The method of claim 23 further comprising:  
determining the authenticity of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the authenticity of the bill cannot be determined.

25. The method of claim 23 further comprising:  
determining the denomination of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the denomination of the bill cannot be determined

26. The method of claim 19 wherein reversing the face orientation of a bill further comprises reversing the face orientation of a bill with a bill facing mechanism.

27. A method of creating identifiable smaller stacks of currency bills within a larger stack of currency bills with a currency evaluation device, the method comprising:  
receiving a stack of currency bills of a plurality of denominations in an input receptacle;  
transporting the bills from the input receptacle, one at a time, past an evaluating unit to a plurality of output receptacles, the plurality of output receptacles corresponding to the plurality of denominations;  
assigning a target orientation to each of the plurality of output receptacles,

defining the target orientation assigned to each of the plurality of output receptacles to be one of two face orientations, one of the two face orientations being face-down, the other of the two face orientations being face-up;

determining the denomination and face orientation of each of the bills with the evaluating unit;

comparing the face orientation of a bill with the target orientation assigned to the output receptacle corresponding to the determined denomination of the bill;

maintaining the orientation of the bill when the orientation of the bill matches the target orientation;

reversing the orientation of the bill when the orientation of the bill does not match the target orientation;

routing the bill to the output receptacle corresponding to the determined denomination of the bill;

redefining the target orientation assigned to an output receptacle to be the other of the two face orientations after a predetermined number of bills of having a denomination corresponding to the output receptacle have been routed to the output receptacle with a common face orientation; and

repeating the above method, beginning with transporting the bills until each of the bills are transported from the input receptacle.

28. The method of claim 27 further comprising determining the authenticity of each of the currency bills.

29. The method of claim 28 further comprising off-sorting a bill to a particular one of the plurality of output receptacles when the authenticity of the bill can not be determined.

30. The method of claim 27 further comprising totaling the value of the bills transported to the output receptacle.

31. The method of claim 27 further comprising off-sorting a bill to a particular one of the plurality of output receptacles when the denomination of the bill can not be determined.

32. The method of claim 27 wherein reversing the face orientation of a bill further comprises reversing the face orientation of a bill with a bill facing mechanism.

33. A method of creating identifiable smaller stacks of currency bills within larger stacks of currency bills using a currency evaluation device, the method comprising:

(a) defining a target face orientation to be one of two face orientations for each of a plurality of currency bill denominations, one of the two face orientations being face-down, the other of the two face orientations being face-up;

(b) receiving a stack of currency bills of a plurality of denominations in an input receptacle;

(c) transporting the bills from the input receptacle, one at a time, past an evaluating unit to a plurality of output receptacles, the plurality of output receptacles corresponding to the plurality of denominations;

(d) determining the denomination of each of the currency bills with the evaluating unit;

(e) identifying the face orientation of each of the bills with the evaluating unit; and either

(1) maintaining the orientation of a bill when the orientation of the bill matches the target orientation associated with the determined denomination of the bill; or

(2) reversing the orientation of a bill when the orientation of the bill does not match the target orientation associated with the determined denomination of the bill;

(f) routing each of the bills to one of the plurality of output receptacles corresponding to the determined denomination of the bill;

(g) stacking a predetermined number of bills in the plurality of output receptacle s corresponding to the determined denominations of the bills;

(h) redefining the target orientation associated with a particular denomination after a predetermined number of bills have been routed to the particular output receptacle corresponding to the particular denomination; and

(i) repeating (c), (d), (e), (f), (g), and (h) until each of the bills are transported from the input receptacle.

34. The method of claim 33 further comprising determining the authenticity of each of the currency bills.

35. The method of claim 34 further comprising routing a bill to a particular one of the plurality of output receptacles when the authenticity of the currency bill can not be determined

36. The method of claim 33 further comprising totaling the value of the currency bills transported to the output receptacle.

37. The method of claim 33 further comprising routing a bill to a particular one of the plurality of output receptacles when the denomination of the currency bill can not be determined.

38. The method of claim 33 wherein defining a target face orientation further comprises defining the target face orientation to be the face orientation of a first bill transported from the input receptacle.

39. A currency evaluation device for receiving a plurality of bills and evaluating and arranging the bills in a stack, wherein the stack includes a plurality of identifiable smaller stacks, the device comprising:

an input receptacle adapted to receive a plurality of bills to be processed;

at least one output receptacle adapted to receive the bills after the bills have been processed;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the at least one output receptacle;

an evaluating unit adapted to determine the face orientation of each of the bills and to produce a signal indicative of the face orientation of each of the bills;

a bill facing mechanism adapted to rotate a bill approximately 180° to reverse the face orientation of a bill; and

a controller adapted to receive the signal from the evaluating unit and to cause the transport mechanism to direct a bill to the bill facing mechanism when the face orientation of the bill does not match a target orientation so that a predetermined number of bills are transported to the output receptacle with a common face orientation, the controller being adapted to redefine the

target orientation after a predetermined number of bills are transported to the output receptacle with a common face orientation.

40. The currency evaluation device of claim 39 wherein an initial target orientation is the face orientation of a first bill transported from the input receptacle.

41. The currency evaluation device of claim 39 further comprising a user interface being adapted to receive operational instructions from an operator and to display information concerning the bills.

42. The currency evaluation device of claim 41 wherein the operational instructions define an initial target orientation.

43. The currency evaluation device of claim 41 wherein the operational instructions define the predetermined number.

44. The currency evaluation device of claim 39 wherein the evaluating unit is adapted to determine the denomination of the bills.

45. The currency evaluation device of claim 44 wherein the evaluating unit is adapted to determine the value of the currency bills transported to the at least one output receptacle.

46. The currency evaluation device of claim 39 wherein the evaluating unit is adapted to determine the authenticity of the bills.

47. The currency evaluation device of claim 39 wherein the at least one output receptacle comprises a plurality of output receptacles.

48. The currency evaluation device of claim 47 wherein the evaluating unit is adapted to determine the denomination of each of the bills and to produce a signal indicative of the

determined denomination of the bill, the controller being adapted to receive the signal indicative of the determined denomination and to route the bill to a particular one of the plurality of output receptacles based on the determined denomination.

49. The currency evaluation device of claim 48 wherein the evaluating unit is adapted to produce a no call error signal when the denomination of a bill cannot be determined, the controller being adapted to receive the no call error signal and to route the bill triggering the no call error signal to a particular one of the plurality of output receptacles.

50. The currency evaluation device of claim 47 wherein the evaluating unit is adapted to determine the authenticity of each of the bills and to produce suspect document error signal when the authenticity of the bill cannot be determined, the controller being adapted to receive the suspect document error signal and to route the bill triggering the suspect document error signal to a particular one of the plurality of output receptacles.

51. A currency evaluation device for receiving a plurality of bills of mixed denominations and evaluating and arranging the bills in larger stacks, wherein the larger stacks include a plurality of identifiable smaller stacks of currency bills, the device comprising:

- an input receptacle adapted to receive a stack of bills of a plurality of denominations;
- a plurality of output receptacles adapted to receive the bills after the bills have been evaluated, the plurality of output receptacles corresponding to the plurality of denominations;
- a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the plurality of output receptacles;
- an evaluating unit adapted to determine the denomination and the face orientation of each of the bills;
- a bill facing mechanism adapted to rotate a bill approximately 180° to reverse the face orientation of a bill; and
- a controller adapted to cause the transport mechanism to direct a bill to the bill facing mechanism when the face orientation of the bill does not match a target orientation associated with the determined denomination of the bill, the controller being adapted to cause the transport

mechanism to direct a bill to the output receptacle associated with the determined denomination of the bill, the controller being adapted to redefine the target orientation associated with a particular denomination after a predetermined number of bills are transported to the output receptacle associated with the particular denomination with a common face orientation.

52. The currency evaluation device of claim 51 wherein an initial target orientation is the face orientation of a first bill transported from the input receptacle.

53. The currency evaluation device of claim 51 further comprising a user interface being adapted to receive operational instructions from an operator and to display information concerning the bills.

54. The currency evaluation device of claim 53 wherein the operational instructions define an initial target orientation.

55. The currency evaluation device of claim 53 wherein the operational instructions define the predetermined number.

56. The currency evaluation device of claim 51 wherein the evaluating unit is adapted to determine the value of the currency bills transported to the plurality of output receptacles.

57. The currency evaluation device of claim 51 where the controller is adapted to caused the transport mechanism to direct a bill to a particular one of the plurality of output receptacles when the evaluating unit cannot determine the denomination of the bill.

58. The currency evaluation device of claim 51 wherein the evaluating unit is adapted to determine the authenticity of the bills.

59. The currency evaluation device of claim 51 where the controller is adapted to caused the transport mechanism to direct a bill to a particular one of the plurality of output receptacles when the evaluating unit cannot determine the authenticity of the bill.

60. A method of creating identifiable groups of currency bills within a stack of currency bills with a currency evaluation device having a bill facing mechanism, the method comprising:  
receiving a stack of currency bills in an input receptacle;  
transporting each of the bills from the input receptacle, one at a time, past an evaluating unit to at least one output receptacle;  
identifying the face orientation of each of the bills with the evaluating unit;  
stacking the bills in the at least one output receptacle such that the face orientation of each group of bills stacked in the at least one output receptacles alternates from the previous group of bills stacked in the at least one output receptacle, each group comprising a predetermined number of bills.

61. The method of claim 60 further comprising determining the authenticity of each of the currency bills.

62. The method of claim 60 further comprising determining the denomination of each of the currency bills.

63. The method of claim 62 further comprising totaling the value of the currency bills transported to the output receptacle.

64. The method of claim 60 wherein the at least one output receptacle comprises a plurality of output receptacles.

65. The method of claim 64 further comprising:  
determining the authenticity of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the authenticity of the bill cannot be determined.



66. The method of claim 64 further comprising:  
determining the denomination of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the  
denomination of the bill cannot be determined.

**PATENT**  
**47171-000270**

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**APPLICATION FOR UNITED STATES LETTERS PATENT**

For

**METHOD OF CREATING IDENTIFIABLE SMALLER STACKS OF  
CURRENCY BILLS WITHIN A LARGER STACK OF CURRENCY BILLS**

By

Curtis W. Hallowell.

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<p>EXPRESS MAIL MAILING LABEL</p> <p>NUMBER: <u>EK506617072US</u></p> <p>DATE: <u>August 9, 2000</u></p> <p>I hereby certify that this paper or fee is being deposited with the United States Postal Service "EXPRESS MAIL POST OFFICE TO ADDRESSEE" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to: Assistant Commissioner for Patents, Washington D.C. 20231.</p> <p><u>Cornelius Roenpazee</u> Name</p>
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# **METHOD OF CREATING IDENTIFIABLE SMALLER STACKS OF CURRENCY BILLS WITHIN A LARGER STACK OF CURRENCY BILLS**

## **FIELD OF THE INVENTION**

5           The present invention relates generally to the field of currency handling systems and, more particularly, to a method and apparatus for creating identifiable smaller stacks of currency bills within a larger stack of currency bills using a currency handling device.

## **BACKGROUND OF THE INVENTION**

10           A variety of techniques and apparatuses have been used to satisfy the requirements of automated currency handling machines. As businesses and banks grow, these businesses are experiencing a greater volume of paper currency. These businesses are continually requiring not only that their currency be processed more quickly but, also, processed with  
15           more options in a less expensive manner. At the upper end of sophistication in this area of technology are machines that are capable of rapidly identifying, discriminating, and counting multiple currency denominations and then sorting the currency bills into a multitude of output compartments. Further, some of these high-end machines can segregate the processed bills into smaller batches and then bind each of the smaller batches  
20           with a paper strap. Many of these high-end machines are extremely large and expensive such that they are commonly found only in large institutions. These machines are not readily available to businesses which have monetary and space budgets, but still have the need to process large volumes of currency. Other high-end currency handling machines require their own climate controlled environment which may place even greater strains on  
25           businesses having monetary and space budgets.

          Typically, in the handling of bulk currency, after the currency bills have been analyzed, denominated, authenticated, counted and/or otherwise processed, the currency bills are strapped. Bill strapping is a process whereby a stack of a specific number of bills of a single denomination are secured with a paper strap. For example,  
30           one dollar bills are segregated into stacks of one-hundred \$1 bills and then bound with a paper strap. Strapping facilitates the handling of currency by allowing the strapped stacks of bills to be counted rather than the individual currency bills. Traditionally, U.S. currency bills are strapped in one-hundred bill stacks.

The task of bill strapping can increase the amount of time required to process a given batch of currency. Some currency handling machines are able to segregate currency bills into individual denominations, then the operator must manually count the bills into smaller batches for strapping purposes. In other situations, a currency handling device may suspend operation after a predetermined number of bills of a given denomination have been delivered to an output receptacle at which time the operator can remove those bills from the output receptacle and bind the bills with a paper strap. However, this manner of strapping can increase the time required to process a batch of currency bills. Higher end currency processing machines are capable of strapping bills. However, there is an increased cost associated with these higher end machines.

#### SUMMARY OF THE INVENTION

According to one embodiment of the present invention there is provided a method and device for identifying small stacks of currency bills within a larger stack of currency bills using a currency evaluation device. A batch of currency bills to be processed are received in an input receptacle and are transported from the input receptacle, one at a time, past an evaluating unit to at least one output receptacle. The evaluating unit determines information concerning each of the bills including the face orientation of each of the bills. Next it is determined whether the face orientation of each of the bills matches a target face orientation. If the face orientation of a bill matches the target orientation, the face orientation of that bill is maintained. If the face orientation of a bill fails to match the target orientation, the face orientation of that bill is reversed with a bill facing mechanism. Each of the bills are then stacked in the output receptacle. After a predetermined number of bills having a common face orientation are stacked in the output receptacle, the target face orientation is redefined. The bills continue to be processed in this manner until each of the bills are transported from the input receptacle.

The above summary of the present invention is not intended to represent each embodiment, or every aspect, of the present invention. Additional features and benefits of the present invention will become apparent from the detail description, figures, and claim set forth below.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Other objects and advantages of the invention will become apparent upon reading the following detailed description in conjunction with the drawings in which:

5 FIG. 1a is a perspective view of a document handling device according to one embodiment of the invention;

FIG. 1b is a front view of a document handling device according to one embodiment of the invention;

FIG. 2a is a perspective view of an evaluation region according to one embodiment of the document handling device of the present invention;

10 FIG. 2b is a side view of an evaluation region according to one embodiment of the document handling device of the present invention;

FIG. 3a is a perspective view of an input receptacle according to one embodiment of the document handling device of the present invention;

15 FIG. 3b is another perspective view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 3c is a top view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 3d is a side view of an input receptacle according to one embodiment of the document handling device of the present invention;

20 FIG. 4 is a perspective view of a portion of a transportation mechanism according to one embodiment of the present invention;

FIG. 5 is a front perspective view of an escrow compartment, a plunger assembly, and a storage cassette according to one embodiment of the document handling device of the present invention;

25 FIG. 6 is a top view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

FIG. 7 is a front view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

30 FIG. 8 is another front view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

FIG. 9 is a perspective view of an apparatus for transferring currency from an escrow compartment to a storage cassette according to one embodiment of the document handling device of the present invention;

5 FIG. 10 is a perspective view of a paddle according to one embodiment of the document handling device of the present invention;

FIG. 11 is a rear perspective view of the escrow compartment, plunger assembly, and storage cassette according to one embodiment of the document handling device of the present invention;

10 FIG. 12 is a rear view of a plunger assembly wherein the gate is in the open position according to one embodiment of the document handling device of the present invention;

FIG. 13 is a rear view of a plunger assembly wherein the gate is in the closed position according to one embodiment of the document handling device of the present invention;

15 FIG. 14 is a perspective view of a storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 15 is a rear view of a storage cassette according to one embodiment of the document handling device of the present invention;

20 FIG. 16 is a perspective view of a storage cassette showing a door in the open position according to one embodiment of the document handling device of the present invention;

FIG. 17a is a top view of a storage cassette sized to accommodate United States currency documents according to one embodiment of the document handling device of the present invention;

25 FIG. 17b is a rear view of a storage cassette sized to accommodate United States currency documents according to one embodiment of the document handling device of the present invention;

FIG. 18a is a top view of a storage cassette sized to accommodate large documents according to one embodiment of the document handling device of the present invention;

30 FIG. 18b is a rear view of a storage cassette sized to accommodate large documents according to one embodiment of the document handling device of the present invention;

FIG. 19 is a perspective view of a two belt bill facing mechanism according to one embodiment of the present invention;

FIG. 20 is another perspective view of a two belt bill facing mechanism according to one embodiment of the document handling device of the present invention;

FIG 21 is a perspective view of a two belt bill facing mechanism without belt guides or bill guides according to one embodiment of the document handling device of the present invention;

FIG. 22 is a perspective view of a two belt bill facing mechanism without belt guides according to one embodiment of the document handling device of the present invention; and

FIG. 23 is a front view of a stack of currency bills stacked pursuant to a strapping mode of operation according to one embodiment of the present invention;

FIG. 24 is a flow charting illustrating the steps performed when operating pursuant to a strapping mode of operation according to one embodiment of the present invention;

FIG. 25a is a front view of a stack of currency bills stacked pursuant to a strapping mode of operation according to one embodiment of the present invention; and

FIG. 25b is a front view of a stack of currency bills stacked pursuant to a strapping mode of operation according to one embodiment of the present invention.

#### **DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS**

Referring to FIGS. 1a and 1b, a multi-pocket document processing device 100 such as a currency handling device according to one embodiment of the present invention is illustrated. Currency bills are fed, one by one, from a stack of currency bills placed in an input receptacle 102 into a transport mechanism 104. The transport mechanism 104 guides currency bills to one of a plurality of output receptacles 106a-106h, which may include upper output receptacles 106a, 106b, as well as lower output receptacles 106c-106h. Before reaching an output receptacle 106 the transport mechanism 104 guides the bill through an evaluation region 108 where a bill can be, for example, analyzed, authenticated, denominated, counted, and/or otherwise processed. In alternative embodiments of the currency handling device 100 of the

present invention, the evaluation region 108 can determine bill orientation, bill size, or whether bills are stacked upon one another. The results of the above process or processes may be used to determine to which output receptacle 106 a bill is directed. The illustrated embodiment of the currency handling device has an overall width,  $W_1$ , of approximately 4.52 feet (1.38 meters), a height,  $H_1$ , of approximately 4.75 feet (1.45 meters), and a depth,  $D_1$ , of approximately 1.67 feet (0.50 meters).

In one embodiment, documents such as currency bills are transported, scanned, denominated, authenticated and/or otherwise processed at a rate equal to or greater than 600 bills per minute. In another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated, and/or otherwise processed at a rate equal to or greater than 800 bills per minute. In another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated and/or otherwise processed at a rate equal to or greater than 1000 bills per minute. In still another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated, and/or otherwise processed at a rate equal to or greater than 1200 bills per minute.

In the illustrated embodiment, interposed in the bill transport mechanism 104, intermediate the bill evaluation region 108 and the lower output receptacles 106c-106h is a bill facing mechanism designated generally by reference numeral 110. The bill facing mechanism is capable of rotating a bill  $180^\circ$  so that the face orientation of the bill is reversed. The leading edge of the bill (the wide dimension of the bill according to one embodiment) remains constant while the bill is rotated  $180^\circ$  about an axis parallel to the smaller dimension of the bill) so that the face orientation of the bill is reversed. That is, if a U.S. bill, for example, is initially presented with the surface bearing a portrait of a president facing down, it may be directed to the facing mechanism 110, whereupon it will be rotated  $180^\circ$  so that the surface with the portrait faces up. The decision may be taken to send a bill to the facing mechanism 110 when the selected mode of operation or other operator instructions call for maintaining a given face orientation of bills as they are processed by the currency handling device 100. Using U.S. currency as an example, it may be desirable in certain circumstances for all of the bills ultimately delivered to the lower output receptacles 106c-106h to have the bill surface bearing the portrait of the president facing up. In such embodiments of the currency handling device 100, the bill evaluation region 108 is



capable of determining the face orientation of a bill, such that a bill not having the desired face orientation can first be directed to the facing mechanism 110 before being delivered to the appropriate output receptacle 106. Further details of a facing mechanism which may be utilized for this purpose are disclosed in commonly-owned, co-pending U.S. Application Serial No. 09/181,254, entitled "Document Facing Method and Apparatus" which was filed on October 28, 1998, incorporated herein by reference in its entirety, which may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b. Other alternative embodiments of the currency handling device 100 do not include the facing mechanism 110.

The currency handling device 100 in FIG. 1a may be controlled from a separate controller or control unit 120 which has a display/user-interface 122, which may incorporate a touch panel display in one embodiment of the present invention, which displays information, including "functional" keys when appropriate. The display/user-interface 122 may be a full graphics display. Alternatively, additional physical keys or buttons, such as a keyboard 124, may be employed. The control unit 120 may be a self-contained desktop or laptop computer which communicates with the currency handling device 100 via a cable 125. The currency handling device 100 may have a suitable communications port (not shown) for this purpose. In embodiments in which the control unit 120 is a desktop computer wherein the display/user-interface 122 and the desktop computer are physically separable, the desktop computer may be stored within a compartment 126 of the currency handling device 100. In other alternative embodiments, the control unit 120 is integrated into the currency handling device 100 so the control unit 120 is contained within the device 100.

The operator can control the operation of the currency handling device 100 through the control unit 120. Through the control unit 120 the operator can direct the bills into specific output receptacles 106a-106h by selecting various user defined modes. In alternative embodiments, the user can select pre-programmed user defined modes or create new user defined modes based on the particular requirements of the application. For example, the operator may select a user defined mode which instructs the currency handling device 100 to sort bills by denomination; accordingly, the evaluation region 108 would denominate the bills and direct one dollar bills into the first lower output receptacle 106c, five dollar bills into the second lower output

receptacle 106d, ten dollar bills into the third lower output receptacle 106e, twenty dollar bills into the forth lower output receptacle 106f, fifty dollar bills into the fifth lower output receptacle 106g, and one-hundred dollar bills into the sixth lower output receptacle 106h. The operator may also instruct the currency handling device 100 to deliver those bills whose denomination was not determined, no call bills, to the first upper output receptacle 106a. In such an embodiment, upper output receptacle 106a would function as a reject pocket. In an alternative embodiment, the operator may instruct the currency handling device 100 to also evaluate the authenticity of each bill. In such an embodiment, authentic bills would be directed to the appropriate lower output receptacle 106c-106h. Those bills that were determined not to be authentic, suspect bills, would be delivered to the second upper output receptacle 106b. A multitude of user defined modes are disclosed by co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Multi-Pocket Currency Discriminator" which was filed on August 21, 1997, incorporated herein by reference in its entirety, which may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b.

According to one embodiment, the currency handling device 100 is designed so that when the evaluation region 108 is unable to identify certain criteria regarding a bill, the unidentified bill is flagged and "presented" in one of the output receptacles 106a-106h, that is, the transport mechanism 104 is stopped so that the unidentified bill is located at a predetermined position within one of the output receptacles 106a-106h, such as being the last bill transported to one of the output receptacles. Such criteria can include denominating information, authenticating information, information indicative of the bill's series, or other information the evaluation region 108 is attempting to obtain pursuant to a mode of operation. Which output receptacles 106a-106h the flagged bill is presented in may be determined by the user according to a selected mode of operation. For example, where the unidentified bill is the last bill transported to an output receptacle 106a-106h, it may be positioned within a stacker wheel or positioned at the top of the bills already within the output receptacle 106a-106h. While unidentified bills may be transported to any output receptacles 106a-106h, it may be more convenient for the operator to have unidentified bills transported to one of the upper output receptacles 106a,b where the operator is able to easily see and/or inspect the bill which has not been identified by the evaluation region 108. The

operator may then either visually inspect the flagged bill while it is resting on the top of the stack, or alternatively, the operator may decide to remove the bill from the output receptacle 106 in order to examine the flagged bill more closely. In an alternative embodiment of the currency handling device 100, the device 100 may communicate to the user via the display/user-interface 122 in which one of the output receptacles 106a-106h a flagged bill is presented.

The currency handling device 100 may be designed to continue operation automatically when a flagged bill is removed from the upper output receptacle 106a,b or, according to one embodiment of the present invention, the device 100 may be designed to suspend operation and require input from the user via the control unit 120. Upon examination of a flagged bill by the operator, it may be found that the flagged bill is genuine even though it was not identified as so by the evaluation region 108 or the evaluation region 108 may have been unable to denominate the flagged bill. However, because the bill was not identified, the total value and/or denomination counters will not reflect its value. According to one embodiment, such an unidentified bill is removed from the output receptacles 106 and reprocessed or set aside. According to another embodiment, the flagged bills may accumulate in the upper output receptacles 106a,b until the batch of currency bills currently being processed is completed or the output receptacle 106a,b is full and then reprocessed or set aside.

According to another embodiment, when a bill is flagged, the transport mechanism may be stopped before the flagged bill is transported to one of the output receptacles. Such an embodiment is particularly suited for situations in which the operator need not examine the bill being flagged; for example, the currency handling device 100 is instructed to first process United States currency and then British currency pursuant to a selected mode of operation where the currency handling device 100 processes United States \$1, \$5, \$10, \$20, \$50, and \$100 currency bills into the lower output receptacles 106c-106h, respectively. Upon detection of the first British pound note, the currency handling device 100 may halt operation allowing the operator to empty the lower output receptacles 106c-106h and to make any spatial adjustments necessary to accommodate the British currency. A multitude of modes of operation are described in conjunction with bill flagging, presenting, and/or transport halting in commonly owned, co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Method and Apparatus for Document Processing" which was filed on May 28, 1997,

incorporated herein by reference in its entirety above, which may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b.

5 In the illustrated embodiment, with regard to the upper output receptacles 106a, 106b, the second upper output receptacle 106b is provided with a stacker wheel 127 for accumulating a number of bills, while the first upper output receptacle 106a is not provided with such a stacker wheel. Thus, when pursuant to a preprogrammed mode of operation or an operator selected mode or other operator instructions, a bill is to be fed to the first upper output receptacle 106a, there may be a further instruction to  
10 momentarily suspend operation of the currency handling device 100 for the operator to inspect and remove the bill. On the other hand, it may be possible to allow a small number of bills to accumulate in the first upper output receptacle 106a prior to suspending operation. Similarly, the second upper output receptacle 106b may be utilized initially as an additional one of the lower output receptacles 106c-106h.  
15 However, there is no storage cassette associated with the second upper output receptacle 106b. Therefore, when the second upper output receptacle 106b is full, operation may be suspended to remove the bills at such time as yet further bills are directed to the second upper output receptacle 106b in accordance with the selected mode of operation or other operator instructions. In an alternative embodiment of the  
20 currency handling device 100 both the first and the second upper output receptacles 106a, 106b are equipped with a stacker wheel. In such an embodiment both the upper output receptacles 106a,b may also function as the lower output receptacle 106c-106h allowing a number of bills to be stacked therein.

FIGS. 2a and 2b illustrate the evaluation region 108 according to one  
25 embodiment of the currency handling system 100. The evaluation region can be opened for service, access to sensors, clear bill jams, *etc.* as shown in FIG. 2a. The characteristics of the evaluation region 108 may vary according to the particular application and needs of the user. The evaluation region 108 can accommodate a number and variety of different types of sensors depending on a number of variables.  
30 These variables are related to whether the machine is authenticating, counting, or discriminating denominations and what distinguishing characteristics are being examined, *e.g.* size, thickness, color, magnetism, reflectivity, absorbability, transmissivity, electrical conductivity, *etc.* The evaluation region 108 may employ a

variety of detection means including, but not limited to, a size detection and density sensor 408, a lower 410 and an upper 412 optical scan head, a single or multitude of magnetic sensors 414, a thread sensor 416, and an ultraviolet/fluorescent light scan head 418. These detection means and a host of others are disclosed in commonly  
5 owned, co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Multi-Pocket Currency Discriminator," incorporated by reference above.

The direction of bill travel through the evaluation region 108 is indicated by arrow A. The bills are positively driven along a transport plate 400 through the evaluation region 108 by means of a transport roll arrangement comprising both driven  
10 rollers 402 and passive rollers 404. The rollers 402 are driven by a motor (not shown) via a belt 401. Passive rollers 404 are mounted in such a manner as to be freewheeling about their respective axis and biased into counter-rotating contact with the corresponding driven rollers 402. The driven and passive rollers 402, 404 are mounted  
15 so that they are substantially coplanar with the transport plate 400. The transport roll arrangement also includes compressible rollers 406 to aid in maintaining the bills flat against the transport plate 400. Maintaining the bill flat against the transport plate 400 so that the bill lies flat when transported past the sensors enhances the overall reliability of the evaluation processes. A similar transport arrangement is disclosed in  
commonly-owned United States Patent No. 5,687,963 entitled "Method and Apparatus  
20 for Discriminating and Counting Documents," which is incorporated herein by reference in its entirety.

Referring now to FIGS. 3a-3d, the input receptacle 102 of the currency handling device 100 is illustrated. A feeder mechanism such as a pair of stripping wheels 140 aid in feeding the bills in seriatim to the transport mechanism 104 which  
25 first carries the bills through the evaluation region 108. According to one embodiment, the input receptacle 102 includes at least one spring-loaded feeder paddle 142a which is pivotally mounted, permitting it to be pivoted upward and drawn back to the rear of a stack of bills placed in the input receptacle 102 so as to bias the bills towards the evaluation region 108 via the pair of stripping wheels 140. The paddle 142a is coupled  
30 to an advance mechanism 144 to urge the paddle 142a towards the stripping wheels 140. In the illustrated embodiment, motion is imparted to the advance mechanism via a spring 145. In other alternative embodiments, the advance mechanism 144 is motor driven. The advance mechanism 144 is slidably mounted to a shaft 146. The advance

mechanism 144 also constrains the paddle 142a to a linear path. The advance mechanism 144 may contain a liner bearing (not shown) allowing the paddle 142a to easily slide along the shaft 146. In the embodiment illustrated, the paddle 142a may also contain channels 148 to aid in constraining the paddle 142a to a linear path along a pair of tracks 150. The paddle 142a may additionally include a roller 152 to facilitate the movement of the paddle 142a.

In the embodiment illustrated in FIGS. 3a-3d, a second paddle 142b is provided such that a second stack of bills 147 may be placed in the input receptacle 102 behind a first group of bills 149, while the first group of bills 149 is being fed into the currency handling device 100. Thus, the two feeder paddles 142a and 142b may be alternated during processing in order to permit multiple stacks of currency bills to be loaded into the input receptacle 102. In such an embodiment, the operator would retract paddle 142a and place a stack of bills into the input receptacle. Once inside the input receptacle, the operator would place the paddle 142a against the stack of bills so that the paddle 142a biases the stack of bills towards the pair of stripper wheels 140. The operator could then load a second stack of bills into the input receptacle 102 by retracting the second paddle 142b and placing a stack of bills in the input receptacle between the paddles 142a and 142b. The second paddle 142b urges the second stack of bills up against the backside of the first paddle 142a. The operator can then upwardly rotate the first paddle 142a thus combining the two stacks. The first paddle 142a is then retracted to the rear of the input receptacle and the process can be repeated. The two paddle input receptacle allows the operator to more easily continuously feed stacks of bills to the currency handling device 100. In devices not having two feeder paddles, the operator is forced to awkwardly manipulate the two stacks of bills and the advance mechanism. Alternatively, the operator may wait for the stack of bills to be processed out of the input receptacle to add another stack; however, waiting to reload until each stack is processed adds to the total time to process a given amount of currency.

Referring to FIG. 4, a portion of the transport mechanism 104 and diverters 130a-130d are illustrated. A substantial portion of the transport path of the currency handling device 100 positively grips the bills during transport from the pair of stripping wheels 140 through the point where bills are delivered to upper output receptacle 106a or are delivered to the stacker wheels 202 of output receptacles 106b-106h. The

positive grip transport path of the currency handling device 100 is less costly and weighs less than the vacuum transport arrangements of other currency processing devices.

5 The transport mechanism 104 is electronically geared causing all sections to move synchronously from the evaluation region 108 through the point where the bills are delivered to the output receptacles 106. Multiple small motors are used to drive the transport mechanism 104. Using multiple small, less costly motors is more efficient and less costly than a single large motor. Further, less space is consumed enabling the currency handling device 100 to be more compact. Electronically gearing the transport  
10 mechanism 104 enables a single encoder to monitor bill transportation within the currency handling system 100. The encoder is linked to the bill transport mechanism 104 and provides input to a processor to determine the timing of the operations of the currency handling device 100. In this manner, the processor is able to monitor the precise location of the bills as they are transported through the currency handling  
15 device 100. This process is termed "flow control." Input from additional sensors 119 located along the transport mechanism 104 of the currency handling device 100 enables the processor to continually update the position of a bill within the device 100 to accommodate for bill slippage. When a bill leaves the evaluation region 108 the processor expects the bill to arrive at the diverter 130a corresponding to the first lower  
20 output receptacle 106c after a precise number of encoder counts. Specifically, the processor expects the bill to flow past each sensor 119 positioned along the transport mechanism 104 at a precise number of encoder counts. If the bill slips during transport but passes a sensor 119 later within an acceptable number of encoder counts the processor updates or "re-queues" the new bill position. The processor calculates a  
25 new figure for the time the bill is expected to pass the next sensor 119 and arrive at the first diverter 130a. The processor activates a the one of the diverters 130a-f to direct the bill into the appropriate corresponding lower output receptacle 106c-106h when the sensor 119 immediately preceding the diverter 130 detects the passage of the bill to be directed into the appropriate lower output receptacle 106c-h.

30 The currency handling device 100 also uses flow control to detect jams within the transport mechanism 104 of the device 100. When a bill does not reach a sensor 119 within in the calculated number of encoder counts plus the maximum number of counts allowable for slippage, the processor suspends operation of the device 100 and

informs the operator via the display/user-interface 122 that a jam has occurred. The processor also notifies the operator via the display/user-interface 122 of the location of the jam by indicating the last sensor 119 that the bill passed and generally the approximate location of the jam in the system. If the operator cannot easily remove the bill without damage, the operator can then electronically jog the transport path in the forward or reverse direction via the control unit 120 so that the jammed bill is dislodged and the operator can easily remove the bill from the transport path. The operator can then flush the system causing the transport mechanism 104 to deliver all of the bills currently within the transport path of the currency handling device 100 to one of the output receptacles 106. In an alternative embodiment, the user of the currency handling device 100 would have the option when flushing the system to first have the bills already within the escrow regions 116a-116f to be delivered to the respective lower storage cassettes 106c-106h so that those bills may be included in the aggregate value data for the bills being processed. The bills remaining in the transport path 104 would then be delivered to a predetermined escrow region 116 where those bills could be removed and reprocessed by placing those bills in the input receptacle 102.

Utilizing flow control to detect jams is more desirable than prior art currency evaluation machines which do not detect a jam until a sensor is actually physically blocked. The latter method of jam detection permits bills to pile up while waiting for a sensor to become blocked. Bill pile-up is problematic because it may physically halt the machine before the jam is detected and may cause physical damage to the bills and the machine. In order to remedy a jam in a prior art machine, the operator must first manually physically dislodge the jammed bills. The operator must then manually turn a hand crank which advances the transport path until all bills within the transport path are removed. Moreover, because the prior art devices permit multiple bills to pile up before a jam is detected, the integrity of the process is often ruined. In such a case, the entire stack of bills must be reprocessed.

Referring back to FIG. 1a, the illustrated embodiment of the currency handling device 100 includes a total of six lower output receptacles 106c-106h. More specifically, each of the lower output receptacles 106c-106h includes a first portion designated as an escrow compartment 116a-116f and a second portion designated as a storage cassette 118a-118f. Typically, bills are initially directed to the escrow



compartments 116, and thereafter at specified times or upon the occurrence of specified events, which may be selected or programmed by an operator, bills are then fed to the storage cassettes 118. The storage cassettes are removable and replaceable, such that stacks of bills totaling a predetermined number of bills or a predetermined monetary value may be accumulated in a given storage cassette 118, whereupon the cassette may be removed and replaced with an empty storage cassette. In the illustrated embodiment, the number of lower output receptacles 106c-106h including escrow compartments 116 and storage cassettes 118 are six in number. In alternative embodiments, the currency handling device 100 may contain more or less than six lower output receptacles including escrow compartments and storage cassettes 118. In other alternative embodiments, modular lower output receptacles 106 can be implemented to add many more lower output receptacles to the currency handling system 100. Each modular unit may comprise two lower output receptacles. In other alternative embodiments, several modular units may be added at one time to the currency handling device 100.

A series of diverters 130a-130f, which are a part of the transportation mechanism 104, direct the bills to one of the lower output receptacles 106c-106h. When the diverters 130 are in an upper position, the bills are directed to the adjacent lower output receptacle 106. When the diverters 130 are in a lower position, the bills proceed in the direction of the next diverter 130.

The vertical arrangement of the lower output receptacles 106c-106h is illustrated in FIG. 5. The escrow compartment 116 is positioned above the storage cassette 118. In addition to the escrow compartment 116 and the storage cassette 118, each of the lower output receptacles 106c-106h contains a plunger assembly 300. The plunger assembly 300 is shown during its decent towards the storage cassette 118.

Referring now to FIGS. 6 and 7, one of the escrow compartments 116 of the lower output receptacles 106c-106h is shown. The escrow compartment 116 contains a stacker wheel 202 to receive the bills 204 from the diverter 130. The stacker wheel 202 stacks the bills 204 within the escrow compartment walls 206, 208 on top of a gate 210 disposed between the escrow compartment 116 and the storage cassette 118. In an alternative embodiment, the escrow compartment 116 contains a pair of guides to aid in aligning the bills substantially directly on top of one another. The gate 210 is made up of two shutters: a first shutter 211 and a second shutter 212. The shutters

211, 212 are hingedly connected enabling the shutters 211, 212 to rotate downward approximately ninety degrees to move the gate from a first position (closed position) wherein the shutters 211, 212 are substantially co-planer to a second position (open position) wherein the shutters 211, 212 are substantially parallel. Below the gate 210 is the storage cassette 118 (not shown in FIGS. 6 and 7).

FIG. 8 illustrates the positioning of the paddle 302 when transferring a stack of bills from the escrow compartment 116 to the storage cassette 118. When the paddle descends upon the stack of bills 204 it causes shutters 211, 212 to quickly rotate in the directions referred to by arrows B and C, respectively; thus, "snapping" open the gate 210. The quick rotation of the shutters 211, 212 insures that the bills fall into the storage cassette 118 in a substantially stacked position. According to one embodiment, the paddle is programmed to descend after a predetermined number of bills 204 are stacked upon the gate 210. According to other embodiments, the operator can instruct the paddle 302 via the control unit 120 to descend upon the bills 204 stacked upon the gate 210.

Referring now to FIG. 9, the plunger assembly 300 for selectively transferring the bills 204 from an escrow compartment 116 to a corresponding storage cassette 118 and the gate 210 are illustrated in more detail. One such plunger assembly 300 is provided for each of the six lower output receptacles 106c-106h of the currency handling device 100. The plunger assembly 300 comprises a paddle 302, a base 304, and two side arms 306, 308. Each of the shutters 211, 212 comprising the gate 210 extends inwardly from corresponding parallel bars 214, 215. The bars 214, 215 are mounted for pivoting the shutters between the closed position and the open position. Levers 216, 217 are coupled to the parallel bars 214, 215, respectively, to control the rotation of the bars 214, 215 and hence of the shutters 211, 212. Extension springs 218, 219 (shown in FIG. 8) tend to maintain the position of the levers 216, 217 both in the closed and open positions. The shutters 211, 212 have an integral tongue 213a and groove 213b arrangement which prevents any bills which are stacked upon the gate 210 from slipping between the shutters 211, 212.

The base 304 travels along a vertical shaft 311 with which it is slidably engaged. The base 304 may include linear bearings (not shown) to facilitate its movement along the vertical shaft 311. The plunger assembly 300 may also include a vertical guiding member 312 (see FIG. 11) with which the base 304 is also slidably

engaged. The vertical guiding member 312 maintains the alignment of the plunger assembly 300 by preventing the plunger assembly 300 from twisting laterally about the vertical shaft 311 when the paddle 302 forces the bills 204 stacked in the escrow area 116 down into a storage cassette 118.

5 Referring also to FIG. 10, the paddle 302 extends laterally from the base 304. The paddle 302 is secured to a support 314 extending from the base 304. A pair of side arms 306, 308 are hingedly connected to the base. Each of the side arms 306, 308 protrude from the sides of the base 304. Rollers 316, 318 are attached to the side arms 306, 308, respectively, and are free rolling. Springs 313a, 313b are attached to the  
10 side arms 306, 308, respectively, to bias the side arms 306, 308 outward from the base 304. In the illustrated embodiment, the spring 313a, 313b are compression springs.

The paddle 302 contains a first pair of slots 324 to allow the paddle to clear the stacker wheel 202 when descending into and ascending out of the cassette 118. The first pair of slots 324 also enables the paddle 302 to clear the first pair of retaining tabs  
15 350 within the storage cassette (see FIG. 14). Similarly, paddle 302 contains a second pair of slots 326 to enable the paddle 302 to clear the second pair of retaining tabs 350 within the storage cassette 118 (see FIG. 14).

Referring now to FIG. 11, which illustrates a rear view of one of the lower output receptacles 106c-106h, the plunger 300 is bidirectionally driven by way of a belt  
20 328 coupled to an electric motor 330. A clamp 332 engages the belt 328 into a channel 334 in the base 304 of the plunger assembly 300. In the embodiment illustrated in FIG. 11, two plunger assemblies 300 are driven by a single electric motor 330. In one embodiment of the currency handling device, the belt 328 is a timing belt. In other alternative embodiments, each plunger assembly 300 can be driven by a single  
25 electric motor 330. In still other alternative embodiments, there can be any combination of motors 330 to plunger assemblies 300.

FIGS. 12 and 13 illustrate the interaction between the side arms 306, 308 and the levers 216, 217 when the paddle assembly 300 is descending towards and ascending away from the storage cassette 118, respectively. Initially, before  
30 descending towards the cassette, the shutters are in a first (closed) position. In the illustrated embodiment, it is the force imparted by the paddle 302 which opens the gate 210 when the paddle descends towards the storage cassette 118. When the paddle is ascending away from the storage cassette 119, it is the rollers 316, 318 coupled to the

side arms 306, 308 which engage the levers 216, 217 that close the gate 210. The levers 216, 217 shown in FIG. 12 are positioned in the open position. When descending towards the storage cassette 118, the rollers 316, 318 contact the levers 216, 217 and roll around the levers 216, 217 leaving the shutters in the open position. The side arms 306, 308 are hinged in a manner which allows the side arms 306, 308 to rotate inward towards the base 304 as the rollers 316, 318 engage the levers 216, 217. FIG. 13 illustrates the levers in the second position wherein the gate 210 is closed. When the paddle ascends out of the storage cassette, the side arms 306, 308 are biased away from the base 304. The rollers 316, 318 engage the levers 216, 217 causing the levers to rotate upward to the first position thus closing the gate.

FIGS. 14, 15, and 16 illustrate the components of the storage cassettes 118. The bills 204 are stored within the cassette housing 348 which has a base 349. Each storage cassette 118 contains two pairs of retaining tabs 350 positioned adjacent to the interior walls 351, 352 of the storage cassette. The lower surface 354 of each tab 350 is substantially planar. The tabs 350 are hingedly connected to the storage cassette 118 enabling the tabs 350 to downwardly rotate from a horizontal position, substantially perpendicular with the side interior walls 351, 352 of the cassette 118, to a vertical position, substantially parallel to the interior walls 351, 352 of the cassette 118. The tabs 350 are coupled to springs (not shown) to maintain the tabs in the horizontal position.

The storage cassette 118 contains a slidable platform 356 which is biased upward. During operation of the currency handling system 100, the platform 356 receives stacks of bills from the escrow compartment 116. The floor 356 is attached to a base 358 which is slidably mounted to a vertical support member 360. The base 358 is spring-loaded so that it is biased upward and in turn biases the platform 356 upward. The storage cassettes 118 are designed to be interchangeable so that once full, a storage cassette can be easily removed from the currency handling device 100 and replaced with an empty storage cassette 118. In the illustrated embodiment, the storage cassette 118 is equipped with a handle 357 in order to expedite removal and/or replacement of the storage cassettes 118. Also in the illustrated embodiment, the storage cassette 118 has a door 359 which enables an operator to remove bills from the storage cassette 118.

The storage cassettes 118 are dimensioned to accommodate documents of varying sizes. In the illustrated embodiment, the storage cassettes 118 has a height,  $H_2$ , of approximately 15.38 inches (39 cm), a depth,  $D_2$ , of approximately 9 inches (22.9 cm), and a width,  $W_2$ , of approximately 5.66 inches (14.4 cm). The storage cassette illustrated in FIG. 15 has stand-offs 362 to set interior wall 352 off a fixed distance from in the interior wall 353 of the cassette housing 348. The interior walls 351, 352 aid in aligning the bills in a stack within the storage cassettes. The embodiment of the storage cassette illustrate in FIG. 15 is sized to accommodate United States currency documents. To properly accommodate United States currency documents, the interior width of the storage cassette,  $W_3$ , is approximately 2.88 inches. FIGS. 17a and 17b also illustrate an embodiment of the storage cassette 118 sized to accommodate U.S. currency documents which have a width of approximately 2.5 inches (approximately 6.5 cm) and a length of approximately 6 inches (approximately 15.5 cm). In alternative embodiments, the length of the stand-offs 362 can be varied to accommodate documents of varying sizes. For example, the embodiment disclosed in FIG. 18a and 18b has an interior width,  $W_3$  of approximately 4.12 inches (104.6 cm) and is sized to accommodate the largest international currency, the French 500 Franc note, which has width of approximately 3.82 inches (9.7 cm) and a length of approximately 7.17 inches (18.2 cm). In order to accommodate large documents and increase the interior width,  $W_3$ , of the storage cassette 118, the lengths of stand-offs 362, illustrated in FIG. 16b, are shortened.

Beginning with FIG. 7, the operation of one of the lower output receptacles 106c-106h will be described. Pursuant to a mode of operation, the bills 204 are directed by one of the diverters 130 into the escrow compartment 116 of the lower output receptacle. The stacker wheel 202 within escrow compartment 116 receives the bills 204 from the diverter 130. The stacker wheel 202 stacks the bills 204 on top of the gate 210. Pursuant to a preprogrammed mode of operation, once a predetermined number of bills 204 are stacked in the escrow compartment 116, the control unit 120 instructs the currency handling device 100 to suspend processing currency bills and the paddle 302 then descends from its home position above the escrow compartment 116 to transfer the bills 204 into the storage cassette 118. Once the bills 204 have been deposited in the storage cassette 118 the currency handling

device resumes operation until an escrow compartment is full or all the bills within the input receptacle 102 have been processed.

Referring now to FIGS. 8 and 9 the plunger assembly 300 downwardly travels placing the paddle 302 onto of the stack of bills 204. Upon making contact with the bills 204 the paddle 302 continues to travel downward. As the paddle 302 continues its descent, the paddle 302 forces the gate 210 to snap open. The paddle 302 imparts a force to the bills 204 that is transferred to the to the shutters 211, 212 causing the shutters 211, 212 to rotate from the closed position to the open position. The rotation of the shutters 211, 212 is indicated by the arrows B and C, respectively. Once the paddle 302 imparts the amount of force necessary to rotate levers 216, 217, the extension springs 218, 219 quickly rotate the shutters 211, 212 downward, thus "snapping" the gate 210 open. The downward rotation of the shutters 211, 212 causes each of the corresponding parallel bars 214, 215 to pivot which in turn rotates the levers 216, 217. The extension springs 218, 219 maintain the shutters 211, 212 in the open position allowing the paddle 302 to descend into the storage cassette 118. The hingedly connected side arms 306, 308 retract as the rollers 316, 318 to roll around the levers 216, 217 while the plunger assembly 300 is traveling downward into the cassette 118.

Referring now to FIG. 15, once the gate 210 is opened, the bills 204 fall a short distance onto the platform 356 of the storage cassette 118 or onto a stack of bills 204 already deposited on the platform 356. The paddle 302 continues its downward motion towards the storage cassette 118 to ensure that the bills 204 are transferred to the cassette 118. Initially, some bills 204 may be spaced apart from the platform 356 or the other bills 204 within the storage cassette by retaining tabs 350. As the plunger assembly 300 continues to descend downward into the cassette, the paddle 302 continues to urge the stack of bills 204 downward causing the retaining tabs 350 to rotate downward. The bills 204 are pushed past retaining tabs 350 and onto the platform 356.

Once the plunger assembly 300 has descended into the cassette 118 a distance sufficient for the paddle 302 to clear the retaining tabs 350 allowing the retaining tabs 350 to rotate upward, the plunger assembly initiates its ascent out of the storage cassette 118. The platform 356 urges the bills 204 upward against the underside of the paddle 302. The paddle 302 is equipped with two pairs of slots 324, 326 (FIG. 9) to

enable the paddle to clear the pairs of retaining tabs 350. When the paddle 302 ascends past the pairs of retaining tabs 350 the bills 204 are pressed against the lower surfaces 354 of the pairs of retaining tabs 350 by the platform 356.

Referring now to FIG. 13, when the plunger assembly 300 is traveling upward out of the cassette 118, the rollers 316, 318 on the side arms 306, 308 engage the respective levers 216, 217 and move the respective levers 216, 217 from the second (open) position to the first (closed) position to move the gate 210 from the open position to the closed position as the paddle 302 ascends into the escrow compartment 116 after depositing the bills 204 in the storage cassette 118. The paddle 302 is mounted on the base 304 above the rollers 316, 318 on the side arms 306, 308 so that the paddle 302 clears the gate 210 before the gate 210 is moved to the closed position.

In alternative embodiments of the currency handling device 100, the output receptacles 106 can be sized to accommodate documents of varying sizes such as various international currencies, stock certificates, postage stamps, store coupons, *etc.* Specifically, to accommodate documents of different widths, the width of the escrow compartment 116, the gate 210, and the storage cassette 118 would need to be increased or decreased as appropriate. The document evaluation device 100 is sized to accommodate storage cassettes 118 and gates 210 of different widths. The entire transport mechanism 104 of the currency handling device 100 is dimensioned to accommodate the largest currency bills internationally. Accordingly, the document handling device 100 can be used to process the currency or documents of varying sizes.

In various alternative embodiments, the currency handling device 100 is dimensioned to process a stack of different sized currencies at the same time. For example, one application may require the processing of United States dollars (2.5 inches x 6 inches, 6.5 cm x 15.5 cm) and French currency (as large as 7.17 inches x 3.82 inches, 18.2 cm x 9.7 cm). The application may simply require the segregation of the U.S. currency from the French currency wherein the currency handling device 100 delivers U.S. currency to the first lower output receptacle 106c and the French currency to the second output receptacle 106d. In another alternative embodiment, the currency handling device 100 processes a mixed stack of U.S. ten and twenty dollar bills and French one hundred and two hundred Franc notes wherein the currency documents are denominated, counted, and authenticated. In that alternative

embodiment, the U.S. ten and twenty dollar bills are delivered to the first 106c and second 106d lower output receptacles, respectively, and the French one hundred and two hundred Franc notes are delivered to the third 106e and fourth 106f lower output receptacle, respectively. In other alternative embodiments, the currency handling device 100 denominates, counts, and authenticates six different types of currency wherein, for example, Canadian currency is delivered to the first lower output receptacle 106c, United States currency is delivered to the second output receptacle 106d, Japanese currency is delivered to the third lower output receptacle 106e, British currency is delivered to the fourth lower output receptacle 106f, French currency is delivered to the fifth lower output receptacle 106g, and German currency is delivered to the sixth lower output receptacle 106h. In another embodiment, no call bills or other denominations of currency, such as Mexican currency for example, may be directed to the second upper output receptacle 106b. In another embodiment, suspect bills are delivered to the first upper output receptacle 106a.

In other alternative embodiments of the currency handling device 100, the user can vary the type of documents delivered to the output receptacles 106. For example, in one alternative embodiment an operator can direct, via the control unit 120, that a stack of one, five, ten, twenty, fifty, and one-hundred United States dollar bills be denominated, counted, authenticated, and directed into lower output receptacles 106c-106h, respectively. In still another alternative embodiment, the currency handling device 100 is also instructed to deliver other bills, such as a United States two dollar bill or currency documents from other countries that have been mixed into the stack of bills, to the second upper output receptacle 106b. In still another alternative embodiment, the currency handling device 100 is also instructed to count the number and aggregate value of all the currency bills processed and the number and aggregate value of each individual denomination of currency bills processed. These values can be communicated to the user via the display/user-interface 122 of the currency handling device 100. In still another alternative embodiment, no call bills and bills that are stacked upon one another are directed to the second upper output receptacle 106b. In still another alternative embodiment, the operator can direct that all documents failing an authentication test be delivered to the first upper output receptacle 106a. In another alternative embodiment, the operator instructs the currency handling device 100 to deliver no call bills, suspect bills, stacked bills, *etc.* to one of the lower output



receptacles 106c-106h. The currency handling device 100 which has eight output receptacles 106a-106h provides a great deal of flexibility to the user. And in other alternative embodiments of the currency handling device 100, numerous different combinations for processing documents are available.

5           According to one embodiment, the various operations of the currency handling device 100 are controlled by processors disposed on a number of printed circuit boards ("PCBs") such as ten PCBs located throughout the device 100. In one embodiment of the present invention, the processors are Motorola processors, model number 86HC16, manufactured by Motorola, Inc. of Schaumburg, Illinois. Each of the processors are  
10       linked to a central controller via a general purpose communications controller disposed on each PCB. In one embodiment of the present invention the communications controller is an ARCNET communications controller, model COM20020, manufactured by Standard Microsystems Corporation of Hauppauge, New York. The communications controller enables the central controller to quickly and efficiently  
15       communicate with the various components linked to the PCBs.

          According to one embodiment, two PCBs, a "motor board" and a "sensor board," are associated with each pair of lower output receptacles 106c-106h. The first two lower output receptacles 106c,d, the second two lower output receptacles 106e,f, and the last two lower output receptacles 106g,h are paired together. Each of the  
20       lower output receptacles 106 contain sensors which track the movement of the bills into the lower output receptacles 106c-106h, detect whether each storage cassette 118a-118e is positioned within the currency handling device 100, detect whether the doors 359 of the storage cassettes 118 are opened or closed, and whether the cassettes 118 are full. These aforementioned sensors associated with each pair of the lower  
25       output receptacles are tied into a sensor board which is linked to the central controller. The operation of the plunger assembly 300, the stacker wheels 202, the portion of transportation mechanism 104 disposed above the lower output receptacles 116c-116h, and the diverters 130 are controlled by processors disposed on the motor board associated with each pair of lower output receptacle's 106c-106h. Those sensors 130  
30       which track the movement of bills along the transportation mechanism 104 that are disposed directly above the lower output receptacles 106c-106h are also tied into the respective motor boards.

One of the four remaining PCBs is associated with the operation of the one or two stacker wheels 127 associated with the upper output receptacles 106a,b, the stripping wheels 140, the primary drive motor of the evaluation region 108, a diverter which direct bills to the two upper output receptacles 106a,b, and the diverter which then directs bills between the two upper output receptacles 106a,b. The remaining three PCBs are associated with the operation of the transport mechanism 104 and a diverter which directs bills from the transport path to the bill facing mechanism 110. The plurality of sensors 130 disposed along the transport mechanism 104, used to track the movement of bills along the transport mechanism 104, also tied into these three remaining PCBs.

Referring now to FIGS. 19-22, a two belt bill facing mechanism 400 is illustrated. The two belt bill facing mechanism 400 is an alternative embodiment of the bill facing mechanism 110 referred to in FIGS. 1a and 1b and in the above related discussion. The two belt bill facing mechanism 400 can be used in conjunction with the currency handling device 100 shown in FIGS. 1a and 1b to rotate the face orientation of a bill 401 approximately 180°. For example, if a U.S. bill, for example, is initially presented with the surface bearing a portrait of a president facing down, it may be directed to the two belt bill facing mechanism 400, whereupon it will be rotated 180° so that the bill surface with the portrait faces up. The decision may be taken to send a bill 401 to the facing mechanism 400 when the selected mode of operation or other operator instructions call for maintaining a given face orientation of bills as they are processed by the currency handling device 100. For example, it may be desirable in certain circumstances for all of the bills ultimately delivered to the lower output receptacles 106c-106h to have the same face orientation. In such embodiments of the currency handling device 100, the bill evaluation region 108 is capable of determining the face orientation of a bill, such that a bill not having the desired face orientation can first be directed to the two belt bill facing mechanism 400 before being delivered to the appropriate lower output receptacle 106c-106h.

The two belt bill facing mechanism 400 ("facing mechanism") includes a first belt 402 and a second belt 404. Each of the first and the second belts 402,404 forms a continuous loop. The belts 402,404 are disposed adjacent to each other such that the opposing surfaces of each belt 402,404 forms a bill facing transport path 406. The

belts 402, 404 are twisted together so that an inlet 408 of the transport path 406 is rotated approximately 180° with respect to an outlet 410 of the transport path 406.

The first and second belts 402, 404 are each wrapped around two rollers. The first belt 402 is positioned around a first roller 412 disposed adjacent the inlet 408 and a second roller 414 disposed adjacent the outlet 410. The second belt 404 is positioned around a third roller 416 disposed adjacent the inlet 408 and a fourth roller 418 disposed adjacent the outlet 410. As illustrated in FIG. 19, the first and second rollers 412, 414, associated with the first belt, are positioned such that the first roller 412 is the “top” roller at the inlet 408 and the second roller 414 is the “bottom” roller at the outlet 410. The third and fourth rollers 416, 418, associated with the second belt, are positioned such that the third roller 416 is the “bottom” roller at the inlet 408 and the fourth roller 418 is the “top” roller at the outlet 410. This arrangement allows the for the “twisted” bill facing mechanism transport path 406. Starting from the inlet 408, a first end 402a of the first belt 402 is placed around the first roller 412 which is disposed above the third roller 416 around which a first end 404a of the second belt 404 is placed. Viewing FIG. 19 from right to left, the first and the second belts 402, 404 are together twisted 180° out of the page. The second end 404b of the second belt 404 is now disposed above the second end 402b of the first belt 402. The second end 404b of the second belt 404 is positioned around the fourth roller 418 and the second end 402b of the first belt 402 is positioned around the third roller 414. Between the inlet 408 and the outlet 410, that is between the rollers, there is no structure supporting the portions of the first or the second belts 402, 404 which define the bill transport path 406. The rollers are connected to shafts 419 about which the rollers rotate. In one embodiment of the two belt bill facing mechanism, the rollers 414, 418 are driven rollers and the rollers 412, 416 are passive rollers. In such an embodiment, a motor (not shown) is coupled to the shafts 419 associated with driven rollers 414, 418.

Two belt guides 420 (FIGS. 19 and 20) are used to guide the portion of the belts not defining the transport path 406 or the return portion 422 of the belts away from the transport path. The return portion 422 of the belts 402, 404 is drawn away from the transport path 406 to insure that the return portion 422 does not contact a bill 401 traveling along the transport path 406 causing the bill 401 to become skewed

relative to the transport path 406. Each belt guide 420 is attached to a structure 424 which is fixed to the currency handling device 100. In FIGS. 19 and 20, only the first belt guide 420 is clearly illustrated. In the illustrated embodiment, each belt guide 420 includes one vertical roller and two horizontal rollers 426. The vertical roller associated with the second belt guide 420 is labeled with reference number 427. The interior of each belt 402,404 travels against the vertical roller. Any vertical movement of the return portion 422 of the belt is constrained by the two horizontal rollers 426 along which the edges 428,429 of the belts 402,404 travel. In an alternative embodiment, the belt guide 420 only contains one horizontal roller 426 to limit the vertical movement of the return portions of the belts.

In the embodiment illustrated in FIG. 20, the two belt bill facing mechanism contains belt end guides 440. The belt end guides 440 are used to maintain the position of belts 402,404 on rollers 412, 416. The belt guides limit any horizontal movement of the belts 402, 404 at their first ends 402a,404b. In another embodiment of the two, belt bill facing mechanism two more belt end guides are used to limit any horizontal of the belts 402,404 at the second ends 402b,404b. The belt end guides 440 consists of a structure 442 and two rollers 444. Because the belt guides 420 pull the return portion 422 away from the transport path 406, the belt guide rollers 444 maintain the belt ends on the rollers 412, 414, 416, 418 and prohibit any movement of the belts 402,404 off of the rollers 412, 414, 416, 418.

The bill facing mechanism 400 also contains four guides 431,432,433, 434 disposed along the bill transport path 406. Each of these guides are also fixed to the structures 424. The guides 431-434 are made out of a rigid material. A bill is transported through the bill facing mechanism (as well as the through the transport mechanism 104 of currency handling device 100) with the leading edge of the bill being the long or wide edge of the bill 401. The width of the bill 401 is greater than the width of the first and the second belts 402,404 causing a significant portion of the bill 401 to overhang each edge of the belts 402,404. The function of the guides is to provide support to those portions of the bill 401 which overhang the belts 402,404. Because of the high processing rate at which the currency handling device 100 operates, a significant angular velocity is imparted to a bill directed through the facing mechanism. In alternative embodiments of the currency handling device 100, bills are processed at speeds in excess of 1200 bills per minute. The differences in air pressures

acting on the front and the back surfaces areas of the bill 401 can cause the bill 401 to fold or be forced such that the bill is no longer being transported in a substantially flat manner. This situation can occur more readily when the bill stiffness is degraded due to bill wear resulting from heavy usage. Additionally, bills are often folded in a variety of manners which may cause a bill to be biased in a certain direction such that the bill will not lie flat under its own weight. It is preferable for the bill 401 to be transported through the bill facing mechanism 400 (and the currency handling device 100) in a substantially flat manner. If the bill 401 is not substantially flat when traveling from the outlet 410 of the bill facing mechanism 400 back into the bill transport mechanism 104 there is a possibility that the bill may become skewed at the interface between the outlet 410 and the transport mechanism 104 because the transport mechanism 104 may not "catch" the entire leading edge of the bill.

In operation, a bill 401, shown in position E, enters the inlet 408 of the bill facing mechanism 400 and is transported along the bill facing transport path 406 in a direction from right to left indicated by arrow D. The bill 401 adjacent to the outlet 410 is shown in position F which is a 180° rotation from position E. Referring to the bill 401 in position E, the bill 401 has narrow edges 450,451 and surfaces 452, 453. The first and second belts 402,404, a portion of which define the transport path 406, are twisted causing the bill 401 to rotate in manner such that the (near) edge 450 of the bill 401 drops into the page and the (far) edge 451 of the bill 401 rotates up and out of the page. As the bill 401 travels through the bill transport path 406, the surface 452 towards the (near) edge 450 of the bill 401 is guided by the first guide 431. The surface 453 towards the (far) edge 451 of the bill 401 is supported by the second guide 432. The guides 431,432 support their respective surfaces of the bill 401 until the bill 401 is substantially in a vertical position. As the bill continues to travel towards the outlet 410 the edge 451 (now at the top of the page) continues to rotate out of the page while the edge 450 (now at the bottom of the page) rotates into the page. Continuing, the surface 453 towards the edge 451 is being guided by the guide 433. The surface 452 towards edge 450 is being guided by the guide 434. When the bill arrives at the outlet 410, the orientation of the bill has been rotated 180°. The bill then merges into the transport mechanism 104 of the currency handling device 104.

In another alternative embodiment, the currency handling device 100 operates in a strapping mode wherein pursuant to a user's input or selection of a preprogrammed mode of operation, currency bills are stacked in a manner so that smaller stacks of bills within a larger stack of bills are readily identifiable. Typically, in the handling of bulk currency, after the currency bills have been analyzed, 5 denominated, authenticated, counted, and/or otherwise processed, the currency bills are strapped. Bill strapping is a process whereby a stack of a specific number of bills of a single denomination are secured together such as with a paper strap. For example, one dollar bills are segregated into stacks of one-hundred one dollar bills and then bound with a paper strap. Strapping facilitates the handling of bulk currency allowing 10 the strapped stacks of bills to be counted rather than the individual currency bills.

When operating pursuant to a strapping mode, the currency handling device 100 stacks currency bills in the lower output receptacles 106c-106h in a manner so that smaller batches of currency bills are readily identifiable such as by alternating the face 15 orientation of the smaller batches of bills within the stack. Put another way, as illustrated in FIG. 23, every other smaller stack 550 of bills comprising the larger stack 552 of bills is either orientated with the surface of the bill bearing the portrait of the president face-up or face-down. This arrangement allows a user of the currency handling device 100 to quickly segregate the smaller stacks 550 from the larger stack 552 of bills for strapping purposes after the user removes the larger stack 552 of bills 20 from the storage cassette 118a-f associated with a corresponding lower output receptacle 106c-h. For example, a user desiring to "strap" U.S. \$20 bills would instruct the currency handling device accordingly, so that the face-orientation of every batch of one-hundred \$20 bills would alternate.

A bill turnover mechanism, such as for example, either the two belt bill facing 25 mechanism 400, illustrated in FIGS. 19-22, or the bill facing mechanism 110, referred to in FIGS. 1a and 1b, can be incorporated into the currency handling device 100 to vary the face orientation of the bills pursuant to a strapping mode so that the individual currency bills within each smaller stack 550 of currency bills has a common face 30 orientation. Alternatively, in other embodiments of the present invention, other turnover mechanisms can be used.

The total number of bills per smaller stack 550 of currency bills is referred to as a "limit." The "limit" is a predetermined number which is either defined by the user of

the currency handling system 100 or is defined by a mode of operation. In one embodiment, the user defines via the user interface 122 that the limit is, for example, fifty currency bills. Accordingly, the face orientation of every fifty currency bills is alternated. In another alternative embodiment, a user selects via the user interface 122 a “\$20 strapping mode” wherein, for example, the limit is predefined at one hundred \$20 bills. While any number of bills can be included in a strap of currency bills, U.S. currency bills are traditionally strapped in one-hundred bill stacks.

Referring also to FIG. 24, the steps performed in a strapping mode of operation will be described in detail. For purposes of this example, the stack of bills consists of U.S. \$20 bills arranged in both face orientations. Initially at steps 502, 504, and 506, the limit is defined, the bill count is set to zero, and the target orientation is defined, respectively. The target face orientation is the face orientation in which the first smaller stack of bills are to have when stacked in a particular output receptacle 106c-106h such as output receptacle 106f. The target orientation, either face-up or face-down, can be predetermined pursuant to a mode of operation or be input by a user at step 506. In an alternative embodiment of the currency handling device 100, the target orientation can be defined as the orientation of the first currency bill transported though the evaluation region 108 or the first currency bill of a given denomination transported though the evaluation region 108. The initial target orientation dictates the orientation of the first smaller currency bill stack 550 stacked on the platform 356 of a particular storage cassette 118a-f. Accordingly, the initial target orientation of the strapping mode which resulted in the stack of currency bills illustrated in FIG. 23 was face-up.

Upon the commencement of the operation of the currency handling device 100, the bills are transported one at a time through the evaluation region 108 to one of the output receptacles 106c-h. At step 508, while being transported through the evaluation region 108, the face orientation of each of the bills is determined. The face orientation of the bill currently being evaluated is compared to the target orientation at 510. If the orientation of the currency bill currently being evaluated matches the target orientation, the face orientation of the bill is maintained at step 512 and the bill is transported to a particular one of the output receptacles 106c-h at step 514. If the orientation of the currency bill currently being evaluated fails to match the target orientation, the bill is first transported to the bill facing mechanism 400 at step 516,

where the face orientation of the bill is reversed as the bill is rotated 180°. The properly faced bill is then transported to and stacked in a particular one of the output receptacles 106c-h at step 514. As each bill is transported to the output receptacle 106c-106h, at step 516, a bill counter increases by one until the number of bills transported to the particular output receptacle 106c-h having a common face orientation is equivalent to the strap limit. The strap limit is compared to the bill count at step 518. When the bill count is equivalent to the strap limit, the target face orientation is redefined to be the other of the two face orientations – face-up or face-down – at step 520. The bill count is then reset to zero at step 522. The currency evaluation device continues to operate in this manner until the entire batch of currency bills is processed.

The foregoing is one example of the steps performed in processing currency bills with the currency handling device 100 pursuant to a stacking mode of operation. In alternative embodiments, the sequence in which the steps are performed can be rearranged in a variety of other orders or combined. For example, in an alternative embodiment, the steps Define The Limit 502, Set Bill Count To Zero 504, and Define The Target Orientation 506 can be combined in a preprogrammed strapping mode of operation which the user simply selects from the user interface 122. For example, a “\$50 strapping” mode of operation may be selected by the user, via the user interface 122, wherein the limit is predefined at one-hundred bills, the bill count is set to zero, and the initial target orientation is defined as face-down.

In alternative embodiments of the present invention, the currency bills can be processed into the lower output receptacles 106c-h in a variety of manners. For example, in one embodiment, bills are processed into the escrow region 116 until the escrow region 116 is full. At that time, the plunger assembly 300 transfers the bills from the escrow region 116 to the corresponding storage cassette 118. The currency handling device 100 operates in this manner until all of the bills have been processed into the storage cassette(s) 118. If, after all of the bills have been processed, a smaller stack of bills has been delivered to a storage cassette 118 containing a number of bills which is less than the strap limit, the currency handling device 100 can notify the user via the user interface 122. In still another alternative embodiment, after a number of bills equivalent to the strap limit are processed into the escrow region 116, the plunger assembly 300 transfers the bills to the storage cassette 300. In this embodiment of a



strapping mode of operation, all of the smaller stacks of bills in the storage cassette comprise a number of bills equivalent to the strap limit. A stack of bill comprising a number of currency bill less then the limit remains in the escrow region until either the stack is removed by the operator of the currency handling device 100 or until the stack is supplemented with bills from an additional batch of currency processed by the currency handling device.

After the entire batch of currency bills is processed into the lower output receptacles 106c-h pursuant to a strapping mode of operation, a user of the currency handling device 100 removes the stacks of bills from each storage cassette 118a-f associated with corresponding lower output receptacles 106c-h. Because the smaller stacks of bills within each of the larger stacks of bills removed from the storage cassettes 118a-f are arranged with alternating face orientations, the user can quickly segregate the smaller stacks from the larger stacks and bind each of the smaller stacks with a strap.

In an alternative embodiment of the present invention, larger stacks of bills comprising smaller stacks of bills having alternative face orientations, such as illustrated in FIG. 23, can be formed in the lower output receptacles 106c-h without using the bill facing mechanism. In such an embodiment, face-up bills are transported to a "target" lower output receptacle and face-down bills are transported to another target lower output receptacle until the limit is reached in both lower output receptacles. The target receptacles 106 are then switched and the process is repeated. For example, bills of a given denomination having a face-up orientation are routed to the first lower output receptacle 106c and bills of the same denomination having a face-down orientation are routed to the second lower output receptacle 106d. Face-up and face-down bills continue to be processed into the first and second lower output receptacles 106c,d, respectively, until a number of bills equivalent to the limit have been processed into the first and second lower output receptacles 106c,d. At that time, the face-up bills are then routed to the second lower output receptacle 106d and the face-down bills are routed to the first lower output receptacle 106c. Bills continue to be processed in this manner until the limit is again reached in both the first and second lower output receptacles 106c,d at which time the target lower output receptacles 106 of the face-up and face-down bills are again switched. The process continues as described until the entire batch of currency is processed and each of the

lower output receptacles 106c,d contain larger stacks of bills comprising smaller stacks having alternating face orientations. Obviously, the limit will be reached in one of the two lower output receptacles 106c,d before the other of the two lower output receptacles 106c,d. Accordingly, the excess bills are off-sorted or, alternatively, a similar method is performed in the adjacent lower output receptacles 106e,f. For example, when the limit is first reached with respect to face-up bills directed to the first lower output receptacle 106c, those face-up bills are then routed to the third lower output receptacle 106e while face-down bills continue to be directed to the second lower output receptacles 106d. Should the limit be reached in the third lower output receptacle 106e before the second lower output receptacle 106d, the face-up bills can then be directed to the next lower output receptacle 106f. When the limit in the second output receptacle 106d is eventually reached, the target lower output receptacles 106c,d of the face-up and face-down bills can be switched as described. While the above example was discussed in conjunction with the processing of only one denomination of currency bills, in other alternative embodiments more than one denomination of currency bills can be processed in a similar manner.

In still other alternative embodiments of the present invention, smaller stacks of bills can be distinguished, for strapping purposes, from larger stacks of bills processed into lower output receptacles in a variety of other manners without alternating the face orientation of consecutive smaller stacks of bills. In one alternative embodiment, dividers such as sheets of paper are injected into the flow of currency bills so that the sheets of paper are disposed between each of the smaller stacks of currency bills. These "separation sheets" may be any one of a variety of colors that are readily distinguishable from the currency bills being processed such as, for example, fluorescent orange, pink, yellow, red, *etc.* Sheets which are readily distinguishable from the currency bills being processed will facilitate the user's identification and segregation of the smaller stacks of currency bills within the larger stack. In other embodiments, a marking on the "separation sheets" denoting the quantity of bills, the denomination of the bills, and/or the value of each smaller stack of bills may provide information to the user of the currency handling device 100.

In still another alternative embodiment, rather than reversing the face orientation of the bills to distinguish the smaller stacks of currency bills, each of the smaller stacks 554 are slightly offset from the previous smaller stack as illustrated in

FIG. 25a. In such an embodiment, each consecutive smaller stack 554 of bills comprising the larger 556 stack may be offset so that the larger stack 556 of bills appear "stepped" in shape. Alternatively, as illustrated in FIG. 25b, each smaller stack of bills 558 are off-set to the left and to the right of a center C of the platform 356 of the storage cassette 118 in which the bills are stacked so that the side of the larger stack of bills 560 appear corrugated in shape.

Many of the aforementioned modes of operation can be combined with a strapping mode in a multitude of alternative embodiments of the present invention.

For example, in an alternative embodiment of the present invention, several denominations of U.S. currency bills may be processed pursuant to a strapping mode of operation. In such an embodiment U.S. \$1, \$5, \$10, \$20, \$50, and \$100 bills are processed pursuant to a strapping mode of operation into the lower output receptacles 106c-106h, respectively – while alternating the face orientation of every set of one-hundred bills within each of the output receptacles. Accordingly, in such an embodiment, the currency handling device must denominate each of the currency bills being processed. Continuing with the current example, when a non-U.S. \$1, \$5, \$10, \$20, \$50, or \$100 bill is detected, such as a Canadian \$1 bill or a U.S. \$2 bill, that bill is off sorted to one of the upper output receptacles 106a,b. Further, the currency handling device 100 can also authenticate each of the currency bills being processing pursuant to a strapping mode of operation. Non-authentic bills can be routed to upper output receptacles 106a,b as well. Alternatively, non-authentic bills can be routed to upper output receptacle 106a and non-U.S. \$1, \$5, \$10, \$20, \$50, or \$100 bills or no call bills are routed to upper output receptacles 106b.

In other alternative embodiments, the currency handling device 100 is capable of denominating, authenticating, and facing for strapping purposes batches of bills containing several different international currencies. For example, in one embodiment of the present invention, a user may desire to segregate, denominate, authenticate, and stack for strapping purposes U.S. \$20, \$50, \$100 bills and Canadian \$20, \$50, \$100 bills. The U.S. \$20, \$50, \$100 dollar bills may be directed to the first three lower output receptacles 106c-e and the Canadian \$20, \$50, \$100 bills may be directed to the second three lower output receptacles 106f-h. Accordingly, the currency handling device must denominate each of the currency bills before directing the bills to a lower output receptacle 106c-h. Non-U.S. \$20, \$50, \$100 bills and non-Canadian \$20, \$50,

\$100 are directed to one of the upper output receptacles 106a,b such as the second upper output receptacle 106b. The bills may also be authenticated. Authentic U.S. \$20, \$50, \$100 bills and Canadian \$20, \$50, \$100 are directed to the appropriate lower output receptacles 106c-h. Those bills which are not authenticated, suspect bills, can be routed to the first upper output receptacle 106a. Further, non-U.S. \$20, \$50, \$100 suspect bills and non-Canadian \$20, \$50, \$100 suspect bills can also be directed to the first upper output receptacle 106a. Additionally, in other alternative embodiments of the present invention, modular output receptacles can be added so that, for example, U.S. \$5 and \$10 bills are processed in the same manner along side the U.S. \$20, \$50, \$100 bills and Canadian \$20, \$50, \$100 bills.

As is apparent from the foregoing discussion, a strapping mode of operation can be combined with other modes of operation to instruct the currency handling device to operate in a multitude of different variations.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and herein described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

**CLAIMS:**

1. A method of creating identifiable smaller stacks of currency bills within a larger stack of currency bills using a currency evaluation device, the method comprising:
  - (a) receiving a stack of currency bills in an input receptacle;
  - 5 (b) transporting the bills from the input receptacle, one at a time, past an evaluating unit to at least one output receptacle;
  - (c) identifying the face orientation of each of the bills with the evaluating unit; and either
    - (1) maintaining the orientation of a bill when the orientation of the bill
      - 10 matches a target orientation; or
      - (2) reversing the orientation of a bill when the orientation of the bill does not match the target orientation;
    - (d) stacking a predetermined number of bills in the at least one output receptacle, the predetermined number of bills having a common face orientation;
    - 15 (e) redefining the target orientation to be the other of the two face orientations after the predetermined number of bills have been transported to the at least one output receptacle; and
    - (f) repeating (b), (c), (d), and (e), until each of the bills are transported from the input receptacle.
- 20 2. The method of claim 1 further comprising determining the authenticity of each of the currency bills.
3. The method of claim 1 further comprising determining the denomination of
  - 25 each of the currency bills.
4. The method of claim 3 further comprising totaling the value of the currency bills transported to the at least one output receptacle.
- 30 5. The method of claim 1 wherein the at least one output receptacle comprises a plurality of output receptacles.

6. The method of claim 5 further comprising:  
 determining the authenticity of each of the currency bills; and  
 routing a bill to a particular one of the plurality of output receptacles when the  
 authenticity of the bill cannot be determined.

5 7. The method of claim 5 further comprising:  
 determining the denomination of each of the currency bills; and  
 routing a bill to a particular one of the plurality of output receptacles when the  
 denomination of the bill cannot be determined

10 8. The method of claim 1 further comprising defining an initial target orientation to  
 be the face orientation of a first bill transported from the input receptacle.

15 9. The method of claim 1 wherein reversing the face orientation of a bill further  
 comprises reversing the face orientation of a bill with a bill facing mechanism.

10. A method of creating identifiable smaller stacks of currency bills within a larger  
 stack of currency bills using a currency evaluation device, the method comprising:

20 (a) defining a target orientation to be one of two face orientations, one of the two  
 face orientations being face-down, the other of the two face orientations being face-up;

(b) receiving a stack of currency bills in an input receptacle;

(c) transporting each of the bills from the input receptacle, one at a time, past an  
 evaluating unit to at least one output receptacle;

25 (d) identifying the face orientation of each of the bills with the evaluating unit; and  
 either

(1) maintaining the orientation of the bill when the orientation of the bill  
 matches the target orientation; or

(2) reversing the orientation of the bill when the orientation of the bill does  
 not match the target orientation;

30 (e) stacking a predetermined number of bills in the at least one output receptacle,  
 the predetermined number of bills having a common face orientation;

(f) redefining the target orientation to be the other of the two face orientations after a predetermined number of bills having been transported to the at least one output receptacle; and

(g) repeating (c), (d), (e), and (f) until each of the bills are transported from the input receptacle.

11. The method of claim 10 further comprising determining the authenticity of each of the currency bills.

12. The method of claim 10 further comprising determining the denomination of each of the currency bills.

13. The method of claim 12 further comprising totaling the value of the currency bills transported to the output receptacle.

14. The method of claim 10 wherein the at least one output receptacle comprises a plurality of output receptacles.

15. The method of claim 14 further comprising:  
determining the authenticity of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the authenticity of the bill cannot be determined.

16. The method of claim 14 further comprising:  
determining the denomination of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the denomination of the bill cannot be determined.

17. The method of claim 10 wherein defining a target orientation further comprises defining the target orientation to be the face orientation of a first bill transported from the input receptacle.

18. The method of claim 10 wherein reversing the orientation of a bill further comprises reversing the face orientation of a bill with a bill facing mechanism.

5 19. A method of creating identifiable smaller stacks of currency bills within a larger stack of currency bills with a currency evaluation device, the method comprising:  
receiving a stack of currency bills in an input receptacle;  
transporting each of the bills from the input receptacle, one at a time, past an  
evaluating unit to at least one output receptacle;  
10 identifying the face orientation of each of the bills with the evaluating unit, the face orientation of the bills being one of two face orientations, one of the two face orientations being face-down, the other of the two face orientations being face-up;  
defining a target orientation to be the face orientation of a first bill transported from the input receptacle;  
15 comparing the face orientation of each of the bills with the target orientation;  
maintaining the face orientation of a bill when the face orientation of the bill matches the target orientation;  
reversing the face orientation of a bill when the face orientation of the bill does not match the target orientation;  
20 stacking a predetermined number of bills in the at least one output receptacle, the predetermined number of bills having a common face orientation;  
redefining the target orientation to be the other of the two face orientations after the predetermined number of bills having a common face orientation have been stacked in the at least one output receptacle; and  
25 repeating the above method, beginning with transporting the bills until each of the bills are transported from the input receptacle.

20. The method of claim 19 further comprising determining the authenticity of each of the currency bills.

30 21. The method of claim 19 further comprising determining the denomination of each of the currency bills.



22. The method of claim 21 further comprising totaling the value of the currency bills transported to the output receptacle.

23. The method of claim 19 wherein the at least one output receptacle comprises a plurality of output receptacles.

24. The method of claim 23 further comprising:  
determining the authenticity of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the authenticity of the bill cannot be determined.

25. The method of claim 23 further comprising:  
determining the denomination of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the denomination of the bill cannot be determined

26. The method of claim 19 wherein reversing the face orientation of a bill further comprises reversing the face orientation of a bill with a bill facing mechanism.

27. A method of creating identifiable smaller stacks of currency bills within a larger stack of currency bills with a currency evaluation device, the method comprising:  
receiving a stack of currency bills of a plurality of denominations in an input receptacle;  
transporting the bills from the input receptacle, one at a time, past an evaluating unit to a plurality of output receptacles, the plurality of output receptacles corresponding to the plurality of denominations;  
assigning a target orientation to each of the plurality of output receptacles,  
defining the target orientation assigned to each of the plurality of output receptacles to be one of two face orientations, one of the two face orientations being face-down, the other of the two face orientations being face-up;  
determining the denomination and face orientation of each of the bills with the evaluating unit;

comparing the face orientation of a bill with the target orientation assigned to the output receptacle corresponding to the determined denomination of the bill;

maintaining the orientation of the bill when the orientation of the bill matches the target orientation;

5 reversing the orientation of the bill when the orientation of the bill does not match the target orientation;

routing the bill to the output receptacle corresponding to the determined denomination of the bill;

10 redefining the target orientation assigned to an output receptacle to be the other of the two face orientations after a predetermined number of bills of having a denomination corresponding to the output receptacle have been routed to the output receptacle with a common face orientation; and

repeating the above method, beginning with transporting the bills until each of the bills are transported from the input receptacle.

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28. The method of claim 27 further comprising determining the authenticity of each of the currency bills.

20 29. The method of claim 28 further comprising off-sorting a bill to a particular one of the plurality of output receptacles when the authenticity of the bill can not be determined.

30. The method of claim 27 further comprising totaling the value of the bills transported to the output receptacle.

25

31. The method of claim 27 further comprising off-sorting a bill to a particular one of the plurality of output receptacles when the denomination of the bill can not be determined.

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32. The method of claim 27 wherein reversing the face orientation of a bill further comprises reversing the face orientation of a bill with a bill facing mechanism.

33. A method of creating identifiable smaller stacks of currency bills within larger stacks of currency bills using a currency evaluation device, the method comprising:

(a) defining a target face orientation to be one of two face orientations for each of a plurality of currency bill denominations, one of the two face orientations being face-down, the other of the two face orientations being face-up;

(b) receiving a stack of currency bills of a plurality of denominations in an input receptacle;

(c) transporting the bills from the input receptacle, one at a time, past an evaluating unit to a plurality of output receptacles, the plurality of output receptacles corresponding to the plurality of denominations;

(d) determining the denomination of each of the currency bills with the evaluating unit;

(e) identifying the face orientation of each of the bills with the evaluating unit; and either

(1) maintaining the orientation of a bill when the orientation of the bill matches the target orientation associated with the determined denomination of the bill; or

(2) reversing the orientation of a bill when the orientation of the bill does not match the target orientation associated with the determined denomination of the bill;

(f) routing each of the bills to one of the plurality of output receptacles corresponding to the determined denomination of the bill;

(g) stacking a predetermined number of bills in the plurality of output receptacles corresponding to the determined denominations of the bills;

(h) redefining the target orientation associated with a particular denomination after a predetermined number of bills have been routed to the particular output receptacle corresponding to the particular denomination; and

(i) repeating (c), (d), (e), (f), (g), and (h) until each of the bills are transported from the input receptacle.

34. The method of claim 33 further comprising determining the authenticity of each of the currency bills.

35. The method of claim 34 further comprising routing a bill to a particular one of the plurality of output receptacles when the authenticity of the currency bill can not be determined

5 36. The method of claim 33 further comprising totaling the value of the currency bills transported to the output receptacle.

10 37. The method of claim 33 further comprising routing a bill to a particular one of the plurality of output receptacles when the denomination of the currency bill can not be determined.

38. The method of claim 33 wherein defining a target face orientation further comprises defining the target face orientation to be the face orientation of a first bill transported from the input receptacle.

15 39. A currency evaluation device for receiving a plurality of bills and evaluating and arranging the bills in a stack, wherein the stack includes a plurality of identifiable smaller stacks, the device comprising:

an input receptacle adapted to receive a plurality of bills to be processed;

20 at least one output receptacle adapted to receive the bills after the bills have been processed;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the at least one output receptacle;

25 an evaluating unit adapted to determine the face orientation of each of the bills and to produce a signal indicative of the face orientation of each of the bills;

a bill facing mechanism adapted to rotate a bill approximately 180° to reverse the face orientation of a bill; and

30 a controller adapted to receive the signal from the evaluating unit and to cause the transport mechanism to direct a bill to the bill facing mechanism when the face orientation of the bill does not match a target orientation so that a predetermined number of bills are transported to the output receptacle with a common face orientation, the controller being adapted to redefine the target orientation after a

predetermined number of bills are transported to the output receptacle with a common face orientation.

5        40.     The currency evaluation device of claim 39 wherein an initial target orientation is the face orientation of a first bill transported from the input receptacle.

41.     The currency evaluation device of claim 39 further comprising a user interface being adapted to receive operational instructions from an operator and to display information concerning the bills.

10       42.     The currency evaluation device of claim 41 wherein the operational instructions define an initial target orientation.

15       43.     The currency evaluation device of claim 41 wherein the operational instructions define the predetermined number.

44.     The currency evaluation device of claim 39 wherein the evaluating unit is adapted to determine the denomination of the bills.

20       45.     The currency evaluation device of claim 44 wherein the evaluating unit is adapted to determine the value of the currency bills transported to the at least one output receptacle.

25       46.     The currency evaluation device of claim 39 wherein the evaluating unit is adapted to determine the authenticity of the bills.

47.     The currency evaluation device of claim 39 wherein the at least one output receptacle comprises a plurality of output receptacles.

30       48.     The currency evaluation device of claim 47 wherein the evaluating unit is adapted to determine the denomination of each of the bills and to produce a signal indicative of the determined denomination of the bill, the controller being adapted to receive the signal indicative of the determined denomination and to route the bill to a

particular one of the plurality of output receptacles based on the determined denomination.

5 49. The currency evaluation device of claim 48 wherein the evaluating unit is adapted to produce a no call error signal when the denomination of a bill cannot be determined, the controller being adapted to receive the no call error signal and to route the bill triggering the no call error signal to a particular one of the plurality of output receptacles.

10 50. The currency evaluation device of claim 47 wherein the evaluating unit is adapted to determine the authenticity of each of the bills and to produce suspect document error signal when the authenticity of the bill cannot be determined, the controller being adapted to receive the suspect document error signal and to route the bill triggering the suspect document error signal to a particular one of the plurality of  
15 output receptacles.

51. A currency evaluation device for receiving a plurality of bills of mixed denominations and evaluating and arranging the bills in larger stacks, wherein the larger stacks include a plurality of identifiable smaller stacks of currency bills, the  
20 device comprising:

an input receptacle adapted to receive a stack of bills of a plurality of denominations;

a plurality of output receptacles adapted to receive the bills after the bills have been evaluated, the plurality of output receptacles corresponding to the plurality of  
25 denominations;

a transport mechanism adapted to transport the bills, one at a time, from the input receptacle to the plurality of output receptacles;

an evaluating unit adapted to determine the denomination and the face orientation of each of the bills;

30 a bill facing mechanism adapted to rotate a bill approximately 180° to reverse the face orientation of a bill; and

a controller adapted to cause the transport mechanism to direct a bill to the bill facing mechanism when the face orientation of the bill does not match a target

orientation associated with the determined denomination of the bill, the controller being adapted to cause the transport mechanism to direct a bill to the output receptacle associated with the determined denomination of the bill, the controller being adapted to redefine the target orientation associated with a particular denomination after a predetermined number of bills are transported to the output receptacle associated with the particular denomination with a common face orientation.

52. The currency evaluation device of claim 51 wherein an initial target orientation is the face orientation of a first bill transported from the input receptacle.

53. The currency evaluation device of claim 51 further comprising a user interface being adapted to receive operational instructions from an operator and to display information concerning the bills.

54. The currency evaluation device of claim 53 wherein the operational instructions define an initial target orientation.

55. The currency evaluation device of claim 53 wherein the operational instructions define the predetermined number.

56. The currency evaluation device of claim 51 wherein the evaluating unit is adapted to determine the value of the currency bills transported to the plurality of output receptacles.

57. The currency evaluation device of claim 51 where the controller is adapted to caused the transport mechanism to direct a bill to a particular one of the plurality of output receptacles when the evaluating unit cannot determine the denomination of the bill.

58. The currency evaluation device of claim 51 wherein the evaluating unit is adapted to determine the authenticity of the bills.

59. The currency evaluation device of claim 51 where the controller is adapted to caused the transport mechanism to direct a bill to a particular one of the plurality of output receptacles when the evaluating unit cannot determine the authenticity of the bill.

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60. A method of creating identifiable groups of currency bills within a stack of currency bills with a currency evaluation device having a bill facing mechanism, the method comprising:

receiving a stack of currency bills in an input receptacle;

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transporting each of the bills from the input receptacle, one at a time, past an ...

evaluating unit to at least one output receptacle;

identifying the face orientation of each of the bills with the evaluating unit;

stacking the bills in the at least one output receptacle such that the face orientation of each group of bills stacked in the at least one output receptacles alternates from the previous group of bills stacked in the at least one output receptacle.

15

61. The method of claim 60 further comprising determining the authenticity of each of the currency bills.

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62. The method of claim 60 further comprising determining the denomination of each of the currency bills.

63. The method of claim 62 further comprising totaling the value of the currency bills transported to the output receptacle.

25

64. The method of claim 60 wherein the at least one output receptacle comprises a plurality of output receptacles.

65. The method of claim 64 further comprising:

30

determining the authenticity of each of the currency bills; and

routing a bill to a particular one of the plurality of output receptacles when the authenticity of the bill cannot be determined.



66. The method of claim 64 further comprising:  
determining the denomination of each of the currency bills; and  
routing a bill to a particular one of the plurality of output receptacles when the  
denomination of the bill cannot be determined.

**ABSTRACT**

A method and device for identifying small stacks of currency bills within a large stack of currency bills using a currency evaluation device. A stack of currency bills to be processed is received in an input receptacle and the bills are transported from the input receptacle, one at a time, past an evaluating unit to at least one output receptacle. The evaluating unit determines the face orientation of each of the bills. Next it is determined whether the face orientation of each of the bills matches a target orientation. If the face orientation of a bill matches the target orientation, the face orientation of that bill is maintained. If the face orientation of a bill fails to match the target orientation, the face orientation of that bills is reversed with a bill facing mechanism. Each of the bills are then stacked in the output receptacle. After a predetermined number of bills having a common face orientation are stacked in the output receptacle, the target face orientation is redefined. The bills continue to be processed in this manner until each of the bills are transported from the input receptacle.

Customer No. 30,223

PATENT

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Continuation Of:

Application Of:

Robert J. Klein *et al.*  
 Serial No.: 09/503,039  
 Filed: February 11, 2000  
 Group Art Unit: 3653

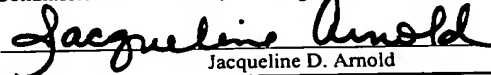
Atty. Docket No. 47171-00364USC1

Serial No.: unknown 10/062,000

Filed: February 1, 2002

Title: TWO BELT BILL FACING  
MECHANISMPRELIMINARY AMENDMENT "A"

Commissioner for Patents  
 Washington, D.C. 20231

EXPRESS MAIL MAILING LABEL	
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I hereby certify that this paper or fee is being deposited with the United States Postal Service "EXPRESS MAIL POST OFFICE TO ADDRESSEE" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to: Commissioner for Patents, Washington D.C. 20231.	
 Jacqueline D. Arnold	

Dear Commissioner:

Applicants respectfully request that prior to the examination of the above-referenced continuation patent application that this Preliminary Amendment "A" be entered.

IN THE ABSTRACT:

On page 34, please delete the Abstract and insert the following new Abstract in place thereof.

-- An apparatus for rotating a document approximately 180° comprises a first and a second belt. The first belt has a document transport portion, a return portion, a first end, and a second end. The second end of first belt being twisted approximately 180° in relation to the first end of the first belt. The second belt has a document transport portion, a return portion, a first end, and second end. The document transport portion of the first belt is disposed adjacent to the document transport portion of the second belt. The second end of second belt

adjacent to the document transport portion of the second belt. The second end of second belt is twisted approximately 180° in relation to the first end of the second belt. A document transport path is defined by the document transport portions of the first and the second belts. The document transport path has an inlet and an outlet. The outlet of the document transport path is twisted approximately 180° in relation to the inlet. A plurality of guides are disposed adjacent to the document facing path for supporting the outer portions of the document which extend beyond a width of the first and the second belts as the document is being transported along the transport path.--

**IN THE SPECIFICATION:**

Page 1, line 1, before "FIELD OF THE INVENTION" insert the following:

**-- CROSS REFERENCE TO RELATED APPLICATIONS**

This application is a continuation of U.S. Application Serial No. 09/503,039, now allowed, which was filed on February 11, 2000. --

**IN THE CLAIMS:**

Please cancel claims 16-20. Please add new claims 21-35 as follows.

21. (New) An apparatus for rotating the orientation of a document approximately 180°, the apparatus comprising:

a first belt having a document transport portion and a return portion, the first belt having a first end and second end, the second end of first belt being twisted approximately 180° in relation to the first end of the first belt;

a second belt having a document transport portion and a return portion, the second belt having a first end and second end, the document transport portion of the first belt being disposed adjacent to the document transport portion of the second belt, the second end of second belt being twisted approximately 180° in relation to the first end of the second belt;

a document transport path being defined by the document transport portions of the first and the second belts, the document transport path having an inlet and an outlet, wherein the outlet of the document transport path is twisted approximately 180° in relation to the inlet; and

a plurality of guides disposed adjacent to the document facing path, the plurality of guides being adapted to support the outer portions of the document which extend beyond a width of the first and the second belts as the document is being transported along the transport path.

22. (New) The apparatus of claim 21 further comprising a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers.

23. (New) The apparatus of claim 22 further comprising a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the second pair of rollers.

24. (New) The apparatus of claim 21 further comprising a first belt guide being adapted to guide the return portion of the first belt away from the document transport path.

25. (New) The apparatus of claim 24 further comprising a second belt guide being adapted to guide the return portion of the second belt away from the document transport path.

26. (New) The apparatus of claim 21 wherein the first belt comprises a continuous loop.

27. (New) The apparatus of claim 26 wherein the second belt comprises a continuous loop.

28. (New) An apparatus for rotating the orientation of a document approximately 180°, the apparatus comprising:

a document transport path having an inlet and an outlet, the transport path being adapted to transport the document from the inlet to the outlet, the transport path being defined by opposing surfaces of a first and a second belt, the first and second belts each having a first and a second end, the second end of the first and second belts being twisted approximately

180° in relation to the first end of the first and second belts, wherein the inlet of the document transport path is rotated approximately 180° in relation to the outlet;

a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers; and

a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the first pair of rollers.

29. (New) The apparatus of claim 28 wherein the first belt includes a return portion, the apparatus further comprising a first belt guide being adapted to guide a portion of the first belt not defining the document transport path away from the transport path.

30. (New) The apparatus of claim 29 wherein the second belt includes a return portion, the apparatus further comprising a second belt guide being adapted to guide a portion of the second belt not defining the document transport path away from the transport path.

31. (New) The apparatus of claim 28 wherein the first belt forms a continuous loop.

32. (New) The apparatus of claim 31 wherein the second belt forms a continuous loop.

33. (New) An apparatus for rotating the orientation of a document approximately 180° comprising:

a first and a second belt having a first end and a second end, each of the first and the second belts forming a continuous loop, each of the first and the second belts having an inner and an outer surface, the first belt being disposed adjacent to the second belt wherein a portion of the outer surfaces of the first and second belts define opposing surfaces of a document facing path, the document facing path having an inlet corresponding to the first end of the first and the second belts and an outlet corresponding to the second ends of the first and the second belts, the first and the second belts being twisted together causing the second ends of the first and second belts to be twisted approximately 180° with respect to the first ends of the first and

the second belts causing the outlet of the document facing path to be twisted approximately 180° with respect to the inlet;

a plurality of guides disposed adjacent to the document facing path, the plurality of guides being adapted to support the outer portions of a document which extend beyond a width of the first and the second belts as the document is being transported along the transport path;

a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers; and

a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the first pair of rollers.

34. (New) The apparatus of claim 33 further wherein the first belt includes a return portion, the apparatus further comprising a first belt guide being adapted to guide the return portion of the first belt away from the transport path.

35. (New) The apparatus of claim 34 further wherein the second belt includes a return portion, the apparatus further comprising a second belt guide being adapted to guide the return portion of the second belt away from the transport path.

### **REMARKS**

Claims 1-15 and 21-35 are pending in the present application. Claims 16-20 have been cancelled. Attached hereto is a clean copy of the pending claims after entry of the present amendment captioned "Pending Claims After Entry of Preliminary Amendment 'A'."

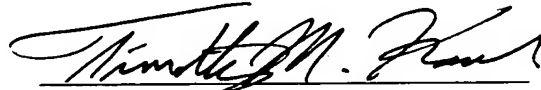
Applicants are submitting a new abstract because the original abstract was objected to in the parent case. Specifically, the abstract in the parent case was objected to for included the word "comprising," which the office indicates is legal phraseology pursuant to MPEP § 608.019(b). The new abstract does not include the word "comprising." Attached is a marked-up version of the Abstract showing the changes made captioned "Marked-Up Abstract Showing Changes Made Pursuant to Preliminary Amendment 'A'."

If there are any matters which may be resolved or clarified through a telephone interview, the Examiner is respectfully requested to contact Applicants' undersigned attorney at the number indicated.

Enclosed is a check in the amount of \$1,088.00 to cover the fees associated with the filing of this "Preliminary Amendment 'A'" and the present continuation application. However, should any fees be deemed necessary (except payment of the issue fee), the Commissioner is authorized to charge any deficiency or to credit any over payment to JENKENS & GILCHRIST, P.C. Account No. 10-0447(47171-00364USC1).

Respectfully submitted,

Date: February 1, 2002



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**Pending Claims After Entry  
of Preliminary Amendment "A"**

1. An apparatus for rotating the orientation of a bill approximately 180°, the apparatus comprising:

a first belt having a bill transport portion and a return portion, the first belt having a first end and second end, the second end of first belt being twisted approximately 180° in relation to the first end of the first belt;

a second belt having a bill transport portion and a return portion, the second belt having a first end and second end, the bill transport portion of the first belt being disposed adjacent to the bill transport portion of the second belt, the second end of second belt being twisted approximately 180° in relation to the first end of the second belt;

a bill transport path being defined by the bill transport portions of the first and the second belts, the bill transport path having an inlet and an outlet, wherein the outlet of the bill transport path is twisted approximately 180° in relation to the inlet; and

a plurality of guides disposed adjacent to the bill facing path, the plurality of guides being adapted to support the outer portions of the bill which extend beyond a width of the first and the second belts as the bill is being transported along the transport path.

2. The apparatus of claim 1 further comprising a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers...

3. The apparatus of claim 2 further comprising a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the second pair of rollers.

4. The apparatus of claim 1 further comprising a first belt guide being adapted to guide the return portion of the first belt away from the transport path.

5. The apparatus of claim 4 further comprising a second belt guide being adapted to guide the return portion of the second belt away from the transport path.

6. The apparatus of claim 1 wherein the first belt comprises a continuous loop.
7. The apparatus of claim 6 wherein the second belt comprises a continuous loop.
8. An apparatus for rotating the orientation of a currency bill approximately 180°, the apparatus comprising:
  - a bill transport path having an inlet and an outlet, the transport path being adapted to transport the bill from the inlet to the outlet, the transport path being defined by opposing surfaces of a first and a second belt, the first and second belts each having a first and a second end, the second end of the first and second belts being twisted approximately 180° in relation to the first end of the first and second belts, wherein the inlet of the transport path is rotated approximately 180° in relation to the outlet;
  - a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers; and
  - a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the first pair of rollers.
9. The apparatus of claim 8 wherein the first belt includes a return portion, the apparatus further comprising a first belt guide being adapted to guide a portion of the first belt not defining the bill transport path away from the transport path.
10. The apparatus of claim 9 wherein the second belt includes a return portion, the apparatus further comprising a second belt guide being adapted to guide a portion of the second belt not defining the bill transport path away from the transport path.
11. The apparatus of claim 8 wherein the first belt forms a continuous loop.
12. The apparatus of claim 11 wherein the second belt forms a continuous loop.

13. An apparatus for rotating the orientation of a currency bill approximately 180° comprising:

a first and a second belt having a first end and a second end, each of the first and the second belts forming a continuous loop, each of the first and the second belts having an inner and an outer surface, the first belt being disposed adjacent to the second belt wherein a portion of the outer surfaces of the first and second belts define opposing surfaces of a bill facing path, the bill facing path having an inlet corresponding to the first end of the first and the second belts and an outlet corresponding to the second ends of the first and the second belts, the first and the second belts being twisted together causing the second ends of the first and second belts to be twisted approximately 180° with respect to the first ends of the first and the second belts causing the outlet of the bill facing path to be twisted approximately 180° with respect to the inlet;

a plurality of guides disposed adjacent to the bill facing path, the plurality of guides being adapted to support the outer portions of a bill which extend beyond a width of the first and the second belts as the bill is being transported along the transport path;

a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers; and

a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the first pair of rollers.

14. The apparatus of claim 13 further wherein the first belt includes a return portion, the apparatus further comprising a first belt guide being adapted to guide the return portion of the first belt away from the transport path.

15. The apparatus of claim 14 further wherein the second belt includes a return portion, the apparatus further comprising a second belt guide being adapted to guide the return portion of the second belt away from the transport path.

21. (New) An apparatus for rotating the orientation of a document approximately 180°, the apparatus comprising:

a first belt having a document transport portion and a return portion, the first belt having a first end and second end, the second end of first belt being twisted approximately  $180^\circ$  in relation to the first end of the first belt;

a second belt having a document transport portion and a return portion, the second belt having a first end and second end, the document transport portion of the first belt being disposed adjacent to the document transport portion of the second belt, the second end of second belt being twisted approximately  $180^\circ$  in relation to the first end of the second belt;

a document transport path being defined by the document transport portions of the first and the second belts, the document transport path having an inlet and an outlet, wherein the outlet of the document transport path is twisted approximately  $180^\circ$  in relation to the inlet; and

a plurality of guides disposed adjacent to the document facing path, the plurality of guides being adapted to support the outer portions of the document which extend beyond a width of the first and the second belts as the document is being transported along the transport path.

22. (New) The apparatus of claim 21 further comprising a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers.

23. (New) The apparatus of claim 22 further comprising a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the second pair of rollers.

24. (New) The apparatus of claim 21 further comprising a first belt guide being adapted to guide the return portion of the first belt away from the document transport path.

25. (New) The apparatus of claim 24 further comprising a second belt guide being adapted to guide the return portion of the second belt away from the document transport path.

26. (New) The apparatus of claim 21 wherein the first belt comprises a continuous loop.

27. (New) The apparatus of claim 26 wherein the second belt comprises a continuous loop.

28. (New) An apparatus for rotating the orientation of a document approximately  $180^\circ$ , the apparatus comprising:

a document transport path having an inlet and an outlet, the transport path being adapted to transport the document from the inlet to the outlet, the transport path being defined by opposing surfaces of a first and a second belt, the first and second belts each having a first and a second end, the second end of the first and second belts being twisted approximately  $180^\circ$  in relation to the first end of the first and second belts, wherein the inlet of the document transport path is rotated approximately  $180^\circ$  in relation to the outlet;

a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers; and

a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the first pair of rollers.

29. (New) The apparatus of claim 28 wherein the first belt includes a return portion, the apparatus further comprising a first belt guide being adapted to guide a portion of the first belt not defining the document transport path away from the transport path.

30. (New) The apparatus of claim 29 wherein the second belt includes a return portion, the apparatus further comprising a second belt guide being adapted to guide a portion of the second belt not defining the document transport path away from the transport path.

31. (New) The apparatus of claim 28 wherein the first belt forms a continuous loop.

32. (New) The apparatus of claim 31 wherein the second belt forms a continuous loop.

33. (New) An apparatus for rotating the orientation of a document approximately  $180^\circ$  comprising:

a first and a second belt having a first end and a second end, each of the first and the second belts forming a continuous loop, each of the first and the second belts having an inner and an outer surface, the first belt being disposed adjacent to the second belt wherein a portion of the outer surfaces of the first and second belts define opposing surfaces of a document facing path, the document facing path having an inlet corresponding to the first end of the first and the second belts and an outlet corresponding to the second ends of the first and the second belts, the first and the second belts being twisted together causing the second ends of the first and second belts to be twisted approximately  $180^\circ$  with respect to the first ends of the first and the second belts causing the outlet of the document facing path to be twisted approximately  $180^\circ$  with respect to the inlet;

a plurality of guides disposed adjacent to the document facing path, the plurality of guides being adapted to support the outer portions of a document which extend beyond a width of the first and the second belts as the document is being transported along the transport path;

a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers; and

a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the first pair of rollers.

34. (New) The apparatus of claim 33 further wherein the first belt includes a return portion, the apparatus further comprising a first belt guide being adapted to guide the return portion of the first belt away from the transport path.

35. (New) The apparatus of claim 34 further wherein the second belt includes a return portion, the apparatus further comprising a second belt guide being adapted to guide the return portion of the second belt away from the transport path.

**Marked-Up Abstract Showing Changes  
Made Pursuant to Preliminary Amendment 'A'**

An apparatus for rotating a bill approximately 180° [comprising] comprising a first and a second belt. The first belt has a bill transport portion, a return portion, a first end, and a second end. The second end of first belt being twisted approximately 180° in relation to the first end of the first belt. The second belt has a bill transport portion, a return portion, a first end, and second end. The bill transport portion of the first belt is disposed adjacent to the bill transport portion of the second belt. The second end of second belt is twisted approximately 180° in relation to the first end of the second belt. A bill transport path is defined by the bill transport portions of the first and the second belts. The bill transport path has an inlet and an outlet. The outlet of the bill transport path is twisted approximately 180° in relation to the inlet. A plurality of guides are disposed adjacent to the bill facing path for supporting the outer portions of the bill which extend beyond a width of the first and the second belts as the bill is being transported along the transport path.

PATENT  
CUMM:263

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APPLICATION FOR UNITED STATES LETTERS PATENT

For

TWO BELT BILL FACING MECHANISM

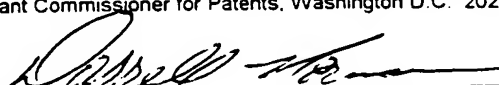
By

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## **TWO BELT BILL FACING MECHANISM**

### **FIELD OF THE INVENTION**

The present invention relates generally to the field of currency handling systems  
5 and, more particularly, to a bill facing mechanism for used in a currency handling  
system.

### **BACKGROUND OF THE INVENTION**

A variety of techniques and apparatuses have been used to satisfy the requirements  
10 of automated currency handling machines. As businesses and banks grow, these businesses  
are experiencing a greater volume of paper currency. These businesses are continually  
requiring not only that their currency be processed more quickly but, also, processed with  
more options in a less expensive manner. At the upper end of sophistication in this area of  
technology are machines that are capable of rapidly identifying, discriminating, and  
15 counting multiple currency denominations and then delivering the sorted currency bills into  
a multitude of output compartments. Many of these high end machines are extremely large  
and expensive such that they are commonly found only in large institutions. These  
machines are not readily available to businesses which have monetary and space budgets,  
but still have the need to process large volumes of currency. Other high end currency  
20 handling machines require their own climate controlled environment which may place even  
greater strains on businesses having monetary and space budgets.

Currency handling machines typically employ magnetic sensing or optical sensing  
for denominating and authenticating currency bills. The results of these processes  
determines to which output compartment a particular bill is delivered to in a currency  
25 handling device having multiple output receptacles. For example, ten dollar denominations  
may be delivered to one output compartment and twenty dollar denominations to another,  
while bills which fail the authentication test are delivered to a third output compartment.  
Unfortunately, many prior art devices only have one output compartment which can be  
appropriately called a reject pocket. Accordingly, in those cases, the reject pocket may have  
30 to accommodate those bills which fail a denomination test or authentication test. As a result,  
different types of "reject" bills are stacked upon one another in the same output  
compartment leaving the operator unknowing as to which of those bills failed which tests.

Many prior art large volume currency handling devices which positively transport the currency bills through the device are susceptible to becoming jammed. And many of these machines are difficult to un-jam because the operator must physically remove the bill from the device. If necessary, the operator can often manipulate a hand-crank to manually jog the device to remove the bills. Then, the operator must manually turn the hand crank to flush out all the bills from within the system before the batch can be reprocessed. Further compounding the problem in a jam situation is that many prior art devices are not equipped to detect the presence of a jam. In such a situation, the device continues to operate until the bills pile up and the jam is so severe that the device is forced to physically halt. This situation can cause physical damage to both the machine and the bills. Often, a jam ruins the integrity of the count and/or valuation of the currency bills so that the entire batch must be reprocessed.

Weight is another draw-back of prior art high-volume currency handling machines. In part, the weight of these machines is due to the heavy machinery used. For example, some machines contain large cast iron rails on which apparatuses ride to push currency bills down into the storage compartments. Unfortunately, the increased weight of these machines often translates into increased costs associated with the machine.

Another disadvantage to some prior art currency handling devices is the manner of feeding bills into the device. Many prior art devices only have one advance mechanism so the operator of the device can only process one stack of bills at a time before reloading the machine. Alternatively, the operator can attempt to simultaneously manipulate the stack of bills currently being processed, a new stack of bills, and the feeder mechanism.

#### **SUMMARY OF THE INVENTION**

According to one embodiment of the present invention, there is provided a multiple output receptacle currency handling device for receiving a stack of currency bills and rapidly processing all the bills in the stack. One aspect of the present invention is directed to an apparatus for rotating a bill approximately 180°. The apparatus comprises a first and a second belt. The first belt has a bill transport portion, a return portion, a first end, and a second end. The second end of first belt being twisted approximately 180° in relation to the first end of the first belt. The second belt has a bill transport portion, a return portion, a first end, and second end. The bill transport portion

of the first belt is disposed adjacent to the bill transport portion of the second belt. The second end of second belt is twisted approximately  $180^\circ$  in relation to the first end of the second belt. A bill transport path is defined by the bill transport portions of the first and the second belts. The bill transport path has an inlet and an outlet. The outlet of the bill transport path is twisted approximately  $180^\circ$  in relation to the inlet. A plurality of guides are disposed adjacent to the bill facing path for supporting the outer portions of the bill which extend beyond a width of the first and the second belts as the bill is being transported along the transport path.

The above summary of the present invention is not intended to represent each embodiment, or every aspect, of the present invention. Additional features and benefits of the present invention will become apparent from the detail description, figures, and claim set forth below.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Other objects and advantages of the invention will become apparent upon reading the following detailed description in conjunction with the drawings in which:

FIG. 1a is a perspective view of a document handling device according to one embodiment of the invention;

FIG. 1b is a front view of a document handling device according to one embodiment of the invention;

FIG. 2a is a perspective view of an evaluation region according to one embodiment of the document handling device of the present invention;

FIG. 2b is a side view of an evaluation region according to one embodiment of the document handling device of the present invention;

FIG. 3a is a perspective view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 3b is another perspective view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 3c is a top view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 3d is a side view of an input receptacle according to one embodiment of the document handling device of the present invention;

FIG. 4 is a perspective view of a portion of a transportation mechanism according to one embodiment of the present invention;

FIG. 5 is a front perspective view of an escrow compartment, a plunger assembly, and a storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 6 is a top view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

FIG. 7 is a front view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

FIG. 8 is another front view of an escrow compartment and plunger assembly according to one embodiment of the document handling device of the present invention;

FIG. 9 is a perspective view of an apparatus for transferring currency from an escrow compartment to a storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 10 is a perspective view of a paddle according to one embodiment of the document handling device of the present invention;

FIG. 11 is a rear perspective view of the escrow compartment, plunger assembly, and storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 12 is a rear view of a plunger assembly wherein the gate is in the open position according to one embodiment of the document handling device of the present invention;

FIG. 13 is a rear view of a plunger assembly wherein the gate is in the closed position according to one embodiment of the document handling device of the present invention;

FIG. 14 is a perspective view of a storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 15 is a rear view of a storage cassette according to one embodiment of the document handling device of the present invention;

FIG. 16 is a perspective view of a storage cassette where the door is open according to one embodiment of the document handling device of the present invention;

FIG. 17a is a top view of a storage cassette sized to accommodate United States currency documents according to one embodiment of the document handling device of the present invention;

FIG. 17b is a rear view of a storage cassette sized to accommodate United States currency documents according to one embodiment of the document handling device of the present invention;

FIG. 18a is a top view of a storage cassette sized to accommodate large documents according to one embodiment of the document handling device of the present invention;

FIG. 18b is a rear view of a storage cassette sized to accommodate large documents according to one embodiment of the document handling device of the present invention;

FIG. 19 is a perspective view of a two belt bill facing mechanism according to one embodiment of the present invention;

FIG. 20 is another perspective view of a two belt bill facing mechanism according to one embodiment of the document handling device of the present invention;

FIG 21 is a perspective view of a two belt bill facing mechanism without belt guides or bill guides according to one embodiment of the document handling device of the present invention; and

FIG. 22 is a perspective view of a two belt bill facing mechanism without belt guides according to one embodiment of the document handling device of the present invention.

## **DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS**

Referring to FIGS. 1a and 1b, a multi-pocket document processing device 100 such as a currency handling device according to one embodiment of the present invention is illustrated. Currency bills are fed, one by one, from a stack of currency bills placed in an input receptacle 102 into a transport mechanism 104. The transport mechanism 104 guides currency bills to one of a plurality of output receptacles 106a-106h, which may include upper output receptacles 106a, 106b, as well as lower output receptacles 106c-106h. Before reaching an output receptacle 106 the transport

mechanism 104 guides the bill through an evaluation region 108 where a bill can be, for example, analyzed, authenticated, denominated, counted, and/or otherwise processed. In alternative embodiments of the currency handling device 100 of the present invention, the evaluation region 108 can determine bill orientation, bill size, or whether bills are  
5 stacked upon one another. The results of the above process or processes may be used to determine to which output receptacle 106 a bill is directed. The illustrated embodiment of the currency handling device has an overall width,  $W_1$ , of approximately 4.52 feet (1.38 meters), a height,  $H_1$ , of approximately 4.75 feet (1.45 meters), and a depth,  $D_1$ , of approximately 1.67 feet (0.50 meters).

10 In one embodiment, documents such as currency bills are transported, scanned, denominated, authenticated and/or otherwise processed at a rate equal to or greater than 600 bills per minute. In another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated, and/or otherwise processed at a rate  
15 equal to or greater than 800 bills per minute. In another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated and/or otherwise processed at a rate equal to or greater than 1000 bills per minute. In still another embodiment, documents such as currency bills are transported, scanned, denominated, authenticated, and/or otherwise processed at a rate equal to or greater than 1200 bills per minute.

20 In the illustrated embodiment, interposed in the bill transport mechanism 104, intermediate the bill evaluation region 108 and the lower output receptacles 106c-106h is a bill facing mechanism designated generally by reference numeral 110. The bill facing mechanism is capable of rotating a bill 180° so that the face position of the bill is reversed. That is, if a U.S. bill, for example, is initially presented with the surface  
25 bearing a portrait of a president facing down, it may be directed to the facing mechanism 110, whereupon it will be rotated 180° so that the surface with the portrait faces up. The leading edge of the bill remains constant while the bill is being rotated 180° by the facing mechanism 110. The decision may be taken to send a bill to the facing mechanism 110 when the selected mode of operation or other operator instructions call for maintaining a  
30 given face position of bills as they are processed by the currency handling device 100. For example, it may be desirable in certain circumstances for all of the bills ultimately delivered to the lower output receptacles 106c-106h to have the bill surface bearing the

portrait of the president facing up. In such embodiments of the currency handling device 100, the bill evaluation region 108 is capable of determining the face position of a bill, such that a bill not having the desired face position can first be directed to the facing mechanism 110 before being delivered to the appropriate output receptacle 106. Further details of a facing mechanism which may be utilized for this purpose are disclosed in commonly-owned, co-pending U.S. Application Serial No. 09/181,254, entitled "Document Facing Method and Apparatus" which was filed on October 28, 1998, incorporated herein by reference in its entirety, which may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b. Other alternative embodiments of the currency handling device 100 do not include the facing mechanism 110.

The currency handling device 100 in FIG. 1a may be controlled from a separate controller or control unit 120 which has a display/user-interface 122, which may incorporate a touch panel display in one embodiment of the present invention, which displays information, including "functional" keys when appropriate. The display/user-interface 122 may be a full graphics display. Alternatively, additional physical keys or buttons, such as a keyboard 124, may be employed. The control unit 120 may be a self-contained desktop or laptop computer which communicates with the currency handling device 100 via a cable 125. The currency handling device 100 may have a suitable communications port (not shown) for this purpose. In embodiments in which the control unit 120 is a desktop computer wherein the display/user-interface 122 and the desktop computer are physically separable, the desktop computer may be stored within a compartment 126 of the currency handling device 100. In other alternative embodiments, the control unit 120 is integrated into the currency handling device 100 so the control unit 120 is contained within the device 100.

The operator can control the operation of the currency handling device 100 through the control unit 120. Through the control unit 120 the operator can direct the bills into specific output receptacles 106a-106h by selecting various user defined modes. In alternative embodiments, the user can select pre-programmed user defined modes or create new user defined modes based on the particular requirements of the application. For example, the operator may select a user defined mode which instructs the currency handling device 100 to sort bills by denomination; accordingly, the evaluation region

108 would denominate the bills and direct one dollar bills into the first lower output receptacle 106c, five dollar bills into the second lower output receptacle 106d, ten dollar bills into the third lower output receptacle 106e, twenty dollar bills into the forth lower output receptacle 106f, fifty dollar bills into the fifth lower output receptacle 106g, and one-hundred dollar bills into the sixth lower output receptacle 106h. The operator may also instruct the currency handling device 100 to deliver those bills whose denomination was not determined, no call bills, to the first upper output receptacle 106a. In such an embodiment, upper output receptacle 106a would function as a reject pocket. In an alternative embodiment, the operator may instruct the currency handling device 100 to also evaluate the authenticity of each bill. In such an embodiment, authentic bills would be directed to the appropriate lower output receptacle 106c-106h. Those bills that were determined not to be authentic, suspect bills, would be delivered to the second upper output receptacle 106b. A multitude of user defined modes are disclosed by co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Multi-Pocket Currency Discriminator" which was filed on August 21, 1997, incorporated herein by reference in its entirety, which may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b.

According to one embodiment, the currency handling device 100 is designed so that when the evaluation region 108 is unable to identify certain criteria regarding a bill, the unidentified note is flagged and "presented" in one of the output receptacles 106a-106h, that is, the transport mechanism 104 is stopped so that the unidentified bill is located at a predetermined position within one of the output receptacles 106a-106h, such as being the last bill transported to one of the output receptacles. Such criteria can include denominating information, authenticating information, information indicative of the bill's series, or other information the evaluation region 108 is attempting to obtain pursuant to a mode of operation. Which output receptacles 106a-106h the flagged bill is presented in may be determined by the user according to a selected mode of operation. For example, where the unidentified bill is the last bill transported to an output receptacle 106a-106h, it may be positioned within a stacker wheel or positioned at the top of the bills already within the output receptacle 106a-106h. While unidentified bills may be transported to any output receptacles 106a-106h, it may be more convenient for the operator to have unidentified bills transported to one of the upper output receptacles



106a,b where the operator is able to easily see and/or inspect the bill which has not been identified by the evaluation region 108. The operator may then either visually inspect the flagged bill while it is resting on the top of the stack, or alternatively, the operator may decide to remove the bill from the output receptacle 106 in order to examine the  
5 flagged bill more closely. In an alternative embodiment of the currency handling device 100, the device 100 may communicate to the user via the display/user-interface 122 in which one of the output receptacles 106a-106h a flagged bill is presented.

The currency handling device 100 may be designed to continue operation automatically when a flagged bill is removed from the upper output receptacle 106a,b or,  
10 according to one embodiment of the present invention, the device 100 may be designed to suspend operation and require input from the user via the control unit 120. Upon examination of a flagged bill by the operator, it may be found that the flagged bill is genuine even though it was not identified as so by the evaluation region 108 or the evaluation may have been unable to denominate the flagged bill. However, because the  
15 bill was not identified, the total value and/or denomination counters will not reflect its value. According to one embodiment, such an unidentified bill is removed from the output receptacles 106 and reprocessed or set aside. According to another embodiment, the flagged bills may accumulate in the upper output receptacles 106a,b until the batch of currency bills currently being processed is completed or the output receptacle 106a,b is  
20 full and then reprocessed or set aside.

According to another embodiment, when a bill is flagged, the transport mechanism may be stopped before the flagged bill is transported to one of the output receptacles. Such an embodiment is particularly suited for situations in which the operator need not examine the bill being flagged; for example, the currency handling  
25 device 100 is instructed to first process United States currency and then British currency pursuant to a selected mode of operation where the currency handling device 100 processes United States \$1, \$5, \$10, \$20, \$50, and \$100 currency bills into the lower output receptacles 106c-106h, respectively. Upon detection of the first British pound note, the currency handling device 100 may halt operation allowing the operator to  
30 empty the lower output receptacles 106c-106h and to make any spatial adjustments necessary to accommodate the British currency. A multitude of modes of operation are described in conjunction with bill flagging, presenting, and/or transport halting in

commonly owned, co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Method and Apparatus for Document Processing" which was filed on May 28, 1997, incorporated herein by reference in its entirety above, which may be employed in conjunction with the present invention such as the device illustrated in FIGS. 1a and 1b.

5 In the illustrated embodiment, with regard to the upper output receptacles 106a, 106b, the second upper output receptacle 106b is provided with a stacker wheel 127 for accumulating a number of bills, while the first upper output receptacle 106a is not provided with such a stacker wheel. Thus, when pursuant to a preprogrammed mode of operation or an operator selected mode or other operator instructions, a bill is to be fed to  
10 the first upper output receptacle 106a, there may be a further instruction to momentarily suspend operation of the currency handling device 100 for the operator to inspect and remove the bill. On the other hand, it may be possible to allow a small number of bills to accumulate in the first upper output receptacle 106a prior to suspending operation. Similarly, the second upper output receptacle 106b may be utilized initially as an  
15 additional one of the lower output receptacles 106c-106h. However, there is no storage cassette associated with the second upper output receptacle 106b. Therefore, when the second upper output receptacle 106b is full, operation may be suspended to remove the bills at such time as yet further bills are directed to the second upper output receptacle 106b in accordance with the selected mode of operation or other operator instructions.  
20 In an alternative embodiment of the currency handling device 100 both the first and the second upper output receptacles 106a, 106b are equipped with a stacker wheel. In such an embodiment both the upper output receptacles 106a,b may also function as the lower output receptacle 106c-106h allowing a number of bills to be stacked therein.

FIGS. 2a and 2b illustrate the evaluation region 108 according to one  
25 embodiment of the currency handling system 100. The evaluation region can be opened for service, access to sensors, clear bill jams, *etc.* as shown in FIG. 2a. The characteristics of the evaluation region 108 may vary according to the particular application and needs of the user. The evaluation region 108 can accommodate a number and variety of different types of sensors depending on a number of variables.  
30 These variables are related to whether the machine is authenticating, counting, or discriminating denominations and what distinguishing characteristics are being examined, *e.g.* size, thickness, color, magnetism, reflectivity, absorbability,

transmissivity, electrical conductivity, etc. The evaluation region 108 may employ a variety of detection means including, but not limited to, a size detection and density sensor 408, a lower 410 and an upper 412 optical scan head, a single or multitude of magnetic sensors 414, a thread sensor 416, and an ultraviolet/fluorescent light scan head 418. These detection means and a host of others are disclosed in commonly owned, co-pending U.S. Patent Application Serial No. 08/916,100 entitled "Multi-Pocket Currency Discriminator," incorporated by reference above.

The direction of bill travel through the evaluation region 108 is indicated by arrow A. The bills are positively driven along a transport plate 400 through the evaluation region 108 by means of a transport roll arrangement comprising both driven rollers 402 and passive rollers 404. The rollers 402 are driven by a motor (not shown) via a belt 401. Passive rollers 404 are mounted in such a manner as to be freewheeling about their respective axis and biased into counter-rotating contact with the corresponding driven rollers 402. The driven and passive rollers 402, 404 are mounted so that they are substantially coplanar with the transport plate 400. The transport roll arrangement also includes compressible rollers 406 to aid in maintaining the bills flat against the transport plate 400. Maintaining the bill flat against the transport plate 400 so that the bill lies flat when transported past the sensors enhances the overall reliability of the evaluation processes. A similar transport arrangement is disclosed in commonly-owned United States Patent No. 5,687,963 entitled "Method and Apparatus for Discriminating and Counting Documents," which is incorporated herein by reference in its entirety.

Referring now to FIGS. 3a-3d, the input receptacle 102 of the currency handling device 100 is illustrated. A feeder mechanism such as a pair of stripping wheels 140 aid in feeding the bills in seriatim to the transport mechanism 104 which first carries the bills through the evaluation region 108. According to one embodiment, the input receptacle 102 includes at least one spring-loaded feeder paddle 142a which is pivotally mounted, permitting it to be pivoted upward and drawn back to the rear of a stack of bills placed in the input receptacle 102 so as to bias the bills towards the evaluation region 108 via the pair of stripping wheels 140. The paddle 142a is coupled to an advance mechanism 144 to urge the paddle 142a towards the stripping wheels 140. In the illustrated embodiment, motion is imparted to the advance mechanism via a spring 145. In other alternative

embodiments, the advance mechanism 144 is motor driven. The advance mechanism 144 is slidably mounted to a shaft 146. The advance mechanism 144 also constrains the paddle 142a to a linear path. The advance mechanism 144 may contain a liner bearing (not shown) allowing the paddle 142a to easily slide along the shaft 146. In the

5 embodiment illustrated, the paddle 142a may also contain channels 148 to aid in constraining the paddle 142a to a linear path along a pair of tracks 150. The paddle 142a may additionally include a roller 152 to facilitate the movement of the paddle 142a.

In the embodiment illustrated in FIGS. 3a-3d, a second paddle 142b is provided such that a second stack of bills 147 may be placed in the input receptacle 102 behind a  
10 first group of bills 149, while the first group of bills 149 is being fed into the currency handling device 100. Thus, the two feeder paddles 142a and 142b may be alternated during processing in order to permit multiple stacks of currency bills to be loaded into the input receptacle 102. In such an embodiment, the operator would retract paddle 142a and place a stack of bills into the input receptacle. Once inside the input receptacle, the  
15 operator would place the paddle 142a against the stack of bills so that the paddle 142a biases the stack of bills towards the pair of stripper wheels 140. The operator could then load a second stack of bills into the input receptacle 102 by retracting the second paddle 142b and placing a stack of bills in the input receptacle between the paddles 142a and 142b. The second paddle 142b urges the second stack of bills up against the backside of  
20 the first paddle 142a. The operator can then upwardly rotate the first paddle 142a thus combining the two stacks. The first paddle 142a is then retracted to the rear of the input receptacle and the process can be repeated. The two paddle input receptacle allows the operator to more easily continuously feed stacks of bills to the currency handling device 100. In devices not having two feeder paddles, the operator is forced to awkwardly  
25 manipulate the two stacks of bills and the advance mechanism. Alternatively, the operator may wait for the stack of bills to be processed out of the input receptacle to add another stack; however, waiting to reload until each stack is processed adds to the total time to process a given amount of currency.

Referring to FIG. 4, a portion of the transport mechanism 104 and diverters 130a-  
30 130d are illustrated. A substantial portion of the transport path of the currency handling device 100 positively grips the bills during transport from the pair of stripping wheels 140 through the point where bills are delivered to upper output receptacle 106a or are

delivered to the stacker wheels 202 of output receptacles 106b-106h. The positive grip transport path of the currency handling device 100 is less costly and weighs less than the vacuum transport arrangements of prior currency processing devices.

5 The transport mechanism 104 is electronically geared causing all sections to move synchronously from the evaluation region 108 through the point where the bills are delivered to the output receptacles 106. Multiple small motors are used to drive the transport mechanism 104. Using multiple small, less costly motors is more efficient and less costly than a single large motor. Further, less space is consumed enabling the currency handling device 100 to be more compact. Electronically gearing the transport  
10 mechanism 104 enables a single encoder to monitor bill transportation within the currency handling system 100. The encoder is linked to the bill transport mechanism 104 and provides input to a processor to determine the timing of the operations of the currency handling device 100. In this manner, the processor is able to monitor the precise location of the bills as they are transported through the currency handling device  
15 100. This process is termed "flow control." Input from additional sensors 119 located along the transport mechanism 104 of the currency handling device 100 enables the processor to continually update the position of a bill within the device 100 to accommodate for bill slippage. When a bill leaves the evaluation region 108 the processor expects the bill to arrive at the diverter 130a corresponding to the first lower  
20 output receptacle 106c after a precise number of encoder counts. Specifically, the processor expects the bill to flow past each sensor 119 positioned along the transport mechanism 104 at a precise number of encoder counts. If the bill slips during transport but passes a sensor 119 later within an acceptable number of encoder counts the processor updates or "re-queues" the new bill position. The processor calculates a new  
25 figure for the time the bill is expected to pass the next sensor 119 and arrive at the first diverter 130a. The processor activates a the one of the diverters 130a-f to direct the bill into the appropriate corresponding lower output receptacle 106c-106h when the sensor 119 immediately preceding the diverter 130 detects the passage of the bill to be directed into the appropriate lower output receptacle 106c-h.

30 The currency handling device 100 also uses flow control to detect jams within the transport mechanism 104 of the device 100. When a bill does not reach a sensor 119 within in the calculated number of encoder counts plus the maximum number of counts

allowable for slippage, the processor suspends operation of the device 100 and informs the operator via the display/user-interface 122 that a jam has occurred. The processor also notifies the operator via the display/user-interface 122 of the location of the jam by indicating the last sensor 119 that the bill passed and generally the approximate location of the jam in the system. If the operator cannot easily remove the bill without damage, the operator can then electronically jog the transport path in the forward or reverse direction via the control unit 120 so that the jammed bill is dislodged and the operator can easily remove the bill from the transport path. The operator can then flush the system causing the transport mechanism 104 to deliver all of the bills currently within the transport path of the currency handling device 100 to one of the output receptacles 106. In an alternative embodiment, the user of the currency handling device 100 would have the option when flushing the system to first have the bills already within the escrow regions 116a-116f to be delivered to the respective lower storage cassettes 106c-106h so that those bills may be included in the aggregate value data for the bills being processed. The bills remaining in the transport path 104 would then be delivered to a predetermined escrow region 116 where those bills could be removed and reprocessed by placing those bills in the input receptacle 102.

Utilizing flow control to detect jams is more desirable than prior art currency evaluation machines which do not detect a jam until a sensor is actually physically blocked. The latter method of jam detection permits bills to pile up while waiting for a sensor to become blocked. Bill pile-up is problematic because it may physically halt the machine before the jam is detected and may cause physical damage to the bills and the machine. In order to remedy a jam in a prior art machine, the operator must first manually physically dislodge the jammed bills. The operator must then manually turn a hand crank which advances the transport path until all bills within the transport path are removed. Moreover, because the prior art devices permit multiple bills to pile up before a jam is detected, the integrity of the process is often ruined. In such a case, the entire stack of bills must be reprocessed.

Referring back to FIG. 1a, the illustrated embodiment of the currency handling device 100 includes a total of six lower output receptacles 106c-106h. More specifically, each of the lower output receptacles 106c-106h includes a first portion designated as an escrow compartment 116a-116f and a second portion designated as a storage cassette

118a-118f. Typically, bills are initially directed to the escrow compartments 116, and thereafter at specified times or upon the occurrence of specified events, which may be selected or programmed by an operator, bills are then fed to the storage cassettes 118. The storage cassettes are removable and replaceable, such that stacks of bills totaling a  
5 predetermined number of bills or a predetermined monetary value may be accumulated in a given storage cassette 118, whereupon the cassette may be removed and replaced with an empty storage cassette. In the illustrated embodiment, the number of lower output receptacles 106c-106h including escrow compartments 116 and storage cassettes 118 are six in number. In alternative embodiments, the currency handling device 100  
10 may contain more or less than six lower output receptacles including escrow compartments and storage cassettes 118. In other alternative embodiments, modular lower output receptacles 106 can be implemented to add many more lower output receptacles to the currency handling system 100. Each modular unit may comprise two lower output receptacles. In other alternative embodiments, several modular units may  
15 be added at one time to the currency handling device 100.

A series of diverters 130a-130f, which are a part of the transportation mechanism 104, direct the bills to one of the lower output receptacles 106c-106h. When the diverters 130 are in an upper position, the bills are directed to the adjacent lower output receptacle 106. When the diverters 130 are in a lower position, the bills proceed in the  
20 direction of the next diverter 130.

The vertical arrangement of the lower output receptacles 106c-106h is illustrated in FIG. 5. The escrow compartment 116 is positioned above the storage cassette 118. In addition to the escrow compartment 116 and the storage cassette 118, each of the lower output receptacles 106c-106h contains a plunger assembly 300. The plunger assembly  
25 300 is shown during its decent towards the storage cassette 118.

Referring now to FIGS. 6 and 7, one of the escrow compartments 116 of the lower output receptacles 106c-106h is shown. The escrow compartment 116 contains a stacker wheel 202 to receive the bills 204 from the diverter 130. The stacker wheel 202 stacks the bills 204 within the escrow compartment walls 206, 208 on top of a gate 210  
30 disposed between the escrow compartment 116 and the storage cassette 118. In an alternative embodiment, the escrow compartment 116 contains a pair of guides to aid in aligning the bills substantially directly on top of one another. The gate 210 is made up of

two shutters: a first shutter 211 and a second shutter 212. The shutters 211, 212 are hingedly connected enabling the shutters 211, 212 to rotate downward approximately ninety degrees to move the gate from a first position (closed position) wherein the shutters 211, 212 are substantially co-planer to a second position (open position) wherein the shutters 211, 212 are substantially parallel. Below the gate 210 is the storage cassette 118 (not shown in FIGS. 6 and 7).

FIG. 8 illustrates the positioning of the paddle 302 when transferring a stack of bills from the escrow compartment 116 to the storage cassette 118. When the paddle descends upon the stack of bills 204 it causes shutters 211, 212 to quickly rotate in the directions referred to by arrows B and C, respectively; thus, "snapping" open the gate 210. The quick rotation of the shutters 211, 212 insures that the bills fall into the storage cassette 118 in a substantially stacked position. According to one embodiment, the paddle is programmed to descend after a predetermined number of bills 204 are stacked upon the gate 210. According to other embodiments, the operator can instruct the paddle 302 via the control unit 120 to descend upon the bills 204 stacked upon the gate 210.

Referring now to FIG. 9, the plunger assembly 300 for selectively transferring the bills 204 from an escrow compartment 116 to a corresponding storage cassette 118 and the gate 210 are illustrated in more detail. One such plunger assembly 300 is provided for each of the six lower output receptacles 106c-106h of the currency handling device 100. The plunger assembly 300 comprises a paddle 302, a base 304, and two side arms 306, 308. Each of the shutters 211, 212 comprising the gate 210 extend inwardly from corresponding parallel bars 214, 215. The bars 214, 215 are mounted for pivoting the shutters between the closed position and the open position. Levers 216, 217 are coupled to the parallel bars 214, 215, respectively, to control the rotation of the bars 214, 215 and hence of the shutters 211, 212. Extension springs 218, 219 (shown in FIG. 8) tend to maintain the position of the levers 216, 217 both in the closed and open positions. The shutters 211, 212 have an integral tongue 213a and groove 213b arrangement which prevents any bills which are stacked upon the gate 210 from slipping between the shutters 211, 212.

The base 304 travels along a vertical shaft 311 with which it is slidably engaged. The base 304 may include linear bearings (not shown) to facilitate its movement along the vertical shaft 311. The plunger assembly 300 may also include a vertical guiding



member 312 (see FIG. 11) with which the base 304 is also slidably engaged. The vertical guiding member 312 maintains the alignment of the plunger assembly 300 by preventing the plunger assembly 300 from twisting laterally about the vertical shaft 311 when the paddle 302 forces the bills 204 stacked in the escrow area 116 down into a storage cassette 118.

Referring also to FIG. 10, the paddle 302 extends laterally from the base 304. The paddle 302 is secured to a support 314 extending from the base 304. A pair of side arms 306, 308 are hingedly connected to the base. Each of the side arms 306, 308 protrude from the sides of the base 304. Rollers 316, 318 are attached to the side arms 306, 308, respectively, and are free rolling. Springs 313a, 313b are attached to the side arms 306, 308, respectively, to bias the side arms 306, 308 outward from the base 304. In the illustrated embodiment, the spring 313a, 313b are compression springs.

The paddle 302 contains a first pair of slots 324 to allow the paddle to clear the stacker wheel 202 when descending into and ascending out of the cassette 118. The first pair of slots 324 also enables the paddle 302 to clear the first pair of retaining tabs 350 within the storage cassette (see FIG. 14). Similarly, paddle 302 contains a second pair of slots 326 to enable the paddle 302 to clear the second pair of retaining tabs 350 within the storage cassette 118 (see FIG. 14).

Referring now to FIG. 11, which illustrates a rear view of one of the lower output receptacles 106c-106h, the plunger 300 is bidirectionally driven by way of a belt 328 coupled to an electric motor 330. A clamp 332 engages the belt 328 into a channel 334 in the base 304 of the plunger assembly 300. In the embodiment illustrated in FIG. 11, two plunger assemblies 300 are driven by a single electric motor 330. In one embodiment of the currency handling device, the belt 328 is a timing belt. In other alternative embodiments, each plunger assembly 300 can be driven by a single electric motor 330. In still other alternative embodiments, there can be any combination of motors 330 to plunger assemblies 300.

FIGS. 12 and 13 illustrate the interaction between the side arms 306, 308 and the levers 216, 217 when the paddle assembly 300 is descending towards and ascending away from the storage cassette 118, respectively. Initially, before descending towards the cassette, the shutters are in a first (closed) position. In the illustrated embodiment, it is the force imparted by the paddle 302 which opens the gate 210 when the paddle

descends towards the storage cassette 118. When the paddle is ascending away from the storage cassette 119, it is the rollers 316, 318 coupled to the side arms 306, 308 which engage the levers 216, 217 that close the gate 210. The levers 216, 217 shown in FIG. 12 are positioned in the open position. When descending towards the storage cassette 118, the rollers 316, 318 contact the levers 216, 217 and roll around the levers 216, 217 leaving the shutters in the open position. The side arms 306, 308 are hinged in a manner which allows the side arms 306, 308 to rotate inward towards the base 304 as the rollers 316, 318 engage the levers 216, 217. FIG. 13 illustrates the levers in the second position wherein the gate 210 is closed. When the paddle ascends out of the storage cassette, the side arms 306, 308 are biased away from the base 304. The rollers 316, 318 engage the levers 216, 217 causing the levers to rotate upward to the first position thus closing the gate.

FIGS. 14, 15, and 16 illustrate the components of the storage cassettes 118. The bills 204 are stored within the cassette housing 348 which has a base 349. Each storage cassette 118 contains two pairs of retaining tabs 350 positioned adjacent to the interior walls 351, 352 of the storage cassette. The lower surface 354 of each tab 350 is substantially planar. The tabs 350 are hingedly connected to the storage cassette 118 enabling the tabs 350 to downwardly rotate from a horizontal position, substantially perpendicular with the side interior walls 351, 352 of the cassette 118, to a vertical position, substantially parallel to the interior walls 351, 352 of the cassette 118. The tabs 350 are coupled to springs (not shown) to maintain the tabs in the horizontal position.

The storage cassette 118 contains a slidable platform 356 which is biased upward. During operation of the currency handling system 100, the platform 356 receives stacks of bills from the escrow compartment 116. The floor 356 is attached to a base 358 which is slidably mounted to a vertical support member 360. The base 358 is spring-loaded so that it is biased upward and in turn biases the platform 356 upward. The storage cassettes 118 are designed to be interchangeable so that once full, a storage cassette can be easily removed from the currency handling device 100 and replaced with an empty storage cassette 118. In the illustrated embodiment, the storage cassette 118 is equipped with a handle 357 in order to expedite removal and/or replacement of the storage cassettes 118. Also in the illustrated embodiment, the storage cassette 118 has a door 359 which enables an operator to remove bills from the storage cassette 118

The storage cassettes 118 are dimensioned to accommodate documents of varying sizes. In the illustrated embodiment, the storage cassettes 118 has a height,  $H_2$ , of approximately 15.38 inches (39 cm), a depth,  $D_2$ , of approximately 9 inches (22.9 cm), and a width,  $W_2$ , of approximately 5.66 inches (14.4 cm). The storage cassette illustrated in FIG. 15 has stand-offs 362 to set interior wall 352 off a fixed distance from the interior wall 353 of the cassette housing 348. The interior walls 351, 352 aid in aligning the bills in a stack within the storage cassettes. The embodiment of the storage cassette illustrated in FIG. 15 is sized to accommodate United States currency documents. To properly accommodate United States currency documents, the interior width of the storage cassette,  $W_3$ , is approximately 2.88 inches. FIGS. 17a and 17b also illustrate an embodiment of the storage cassette 118 sized to accommodate U.S. currency documents which have a width of approximately 2.5 inches (approximately 6.5 cm) and a length of approximately 6 inches (approximately 15.5 cm). In alternative embodiments, the length of the stand-offs 362 can be varied to accommodate documents of varying sizes. For example, the embodiment disclosed in FIG. 18a and 18b has an interior width,  $W_3$  of approximately 4.12 inches (104.6 cm) and is sized to accommodate the largest international currency, the French 500 Franc note, which has width of approximately 3.82 inches (9.7 cm) and a length of approximately 7.17 inches (18.2 cm). In order to accommodate large documents and increase the interior width,  $W_3$ , of the storage cassette 118, the lengths of stand-offs 362, illustrated in FIG. 16b, are shortened.

Beginning with FIG. 7, the operation of one of the lower output receptacles 106c-106h will be described. Pursuant to a mode of operation, the bills 204 are directed by one of the diverters 130 into the escrow compartment 116 of the lower output receptacle. The stacker wheel 202 within escrow compartment 116 receives the bills 204 from the diverter 130. The stacker wheel 202 stacks the bills 204 on top of the gate 210. Pursuant to a preprogrammed mode of operation, once a predetermined number of bills 204 are stacked in the escrow compartment 116, the control unit 120 instructs the currency handling device 100 to suspend processing currency bills and the paddle 302 then descends from its home position above the escrow compartment 116 to transfer the bills 204 into the storage cassette 118. Once the bills 204 have been deposited in the storage cassette 118 the currency handling device resumes operation until an escrow compartment is full or all the bills within the input receptacle 102 have been processed.

Referring now to FIGS. 8 and 9 the plunger assembly 300 downwardly travels placing the paddle 302 onto of the stack of bills 204. Upon making contact with the bills 204 the paddle 302 continues to travel downward. As the paddle 302 continues its descent, the paddle 302 forces the gate 210 to snap open. The paddle 302 imparts a force to the bills 204 that is transferred to the to the shutters 211, 212 causing the shutters 211, 212 to rotate from the closed position to the open position. The rotation of the shutters 211, 212 is indicated by the arrows B and C, respectively. Once the paddle 302 imparts the amount of force necessary to rotate levers 216, 217, the extension springs 218, 219 quickly rotate the shutters 211, 212 downward, thus "snapping" the gate 210 open. The downward rotation of the shutters 211, 212 causes each of the corresponding parallel bars 214, 215 to pivot which in turn rotates the levers 216, 217. The extension springs 218, 219 maintain the shutters 211, 212 in the open position allowing the paddle 302 to descend into the storage cassette 118. The hingedly connected side arms 306, 308 retract as the rollers 316, 318 to roll around the levers 216, 217 while the plunger assembly 300 is traveling downward into the cassette 118.

Referring now to FIG. 15, once the gate 210 is opened, the bills 204 fall a short distance onto the platform 356 of the storage cassette 118 or onto a stack of bills 204 already deposited on the platform 356. The paddle 302 continues its downward motion towards the storage cassette 118 to ensure that the bills 204 are transferred to the cassette 118. Initially, some bills 204 may be spaced apart from the platform 356 or the other bills 204 within the storage cassette by retaining tabs 350. As the plunger assembly 300 continues to descend downward into the cassette, the paddle 302 continues to urge the stack of bills 204 downward causing the retaining tabs 350 to rotate downward. The bills 204 are pushed past retaining tabs 350 and onto the platform 356.

Once the plunger assembly 300 has descended into the cassette 118 a distance sufficient for the paddle 302 to clear the retaining tabs 350 allowing the retaining tabs 350 to rotate upward, the plunger assembly initiates its ascent out of the storage cassette 118. The platform 356 urges the bills 204 upward against the underside of the paddle 302. The paddle 302 is equipped with two pairs of slots 324, 326 (FIG. 9) to enable the paddle to clear the pairs of retaining tabs 350. When the paddle 302 ascends past the pairs of retaining tabs 350 the bills 204 are pressed against the lower surfaces 354 of the pairs of retaining tabs 350 by the platform 356.

Referring now to FIG. 13, when the plunger assembly 300 is traveling upward out of the cassette 118, the rollers 316, 318 on the side arms 306, 308 engage the respective levers 216, 217 and move the respective levers 216, 217 from the second (open) position to the first (closed) position to move the gate 210 from the open position to the closed position as the paddle 302 ascends into the escrow compartment 116 after  
5 depositing the bills 204 in the storage cassette 118. The paddle 302 is mounted on the base 304 above the rollers 316, 318 on the side arms 306, 308 so that the paddle 302 clears the gate 210 before the gate 210 is moved to the closed position.

In alternative embodiments of the currency handling device 100, the output  
10 receptacles 106 can be sized to accommodate documents of varying sizes such as various international currencies, stock certificates, postage stamps, store coupons, *etc.* Specifically, to accommodate documents of different widths, the width of the escrow compartment 116, the gate 210, and the storage cassette 118 would need to be increased or decreased as appropriate. The document evaluation device 100 is sized to  
15 accommodate storage cassettes 118 and gates 210 of different widths. The entire transport mechanism 104 of the currency handling device 100 is dimensioned to accommodate the largest currency bills internationally. Accordingly, the document handling device 100 can be used to process the currency or documents of varying sizes.

In various alternative embodiments, the currency handling device 100 is  
20 dimensioned to process a stack of different sized currencies at the same time. For example, one application may require the processing of United States dollars (2.5 inches x 6 inches, 6.5 cm x 15.5 cm) and French currency (as large as 7.17 inches x 3.82 inches, 18.2 cm x 9.7 cm). The application may simply require the segregation of the U.S. currency from the French currency wherein the currency handling device 100 delivers  
25 U.S. currency to the first lower output receptacle 106c and the French currency to the second output receptacle 106d. In another alternative embodiment, the currency handling device 100 processes a mixed stack of U.S. ten and twenty dollar bills and French one hundred and two hundred Franc notes wherein the currency documents are denominated, counted, and authenticated. In that alternative embodiment, the U.S. ten  
30 and twenty dollar bills are delivered to the first 106c and second 106d lower output receptacles, respectively, and the French one hundred and two hundred Franc notes are delivered to the third 106e and fourth 106f lower output receptacle, respectively. In

other alternative embodiments, the currency handling device 100 denominates, counts, and authenticates six different types of currency wherein, for example, Canadian currency is delivered to the first lower output receptacle 106c, United States currency is delivered to the second output receptacle 106d, Japanese currency is delivered to the third lower output receptacle 106e, British currency is delivered to the fourth lower output receptacle 106f, French currency is delivered to the fifth lower output receptacle 106g, and German currency is delivered to the sixth lower output receptacle 106h. In another embodiment, no call bills or other denominations of currency, such as Mexican currency for example, may be directed to the second upper output receptacle 106b. In another embodiment, suspect bills are delivered to the first upper output receptacle 106a.

In other alternative embodiments of the currency handling device 100, the user can vary the type of documents delivered to the output receptacles 106. For example, in one alternative embodiment an operator can direct, via the control unit 120, that a stack of one, five, ten, twenty, fifty, and one-hundred United States dollar bills be denominated, counted, authenticated, and directed into lower output receptacles 106c-106h, respectively. In still another alternative embodiment, the currency handling device 100 is also instructed to deliver other bills, such as a United States two dollar bill or currency documents from other countries that have been mixed into the stack of bills, to the second upper output receptacle 106b. In still another alternative embodiment, the currency handling device 100 is also instructed to count the number and aggregate value of all the currency bills processed and the number and aggregate value of each individual denomination of currency bills processed. These values can be communicated to the user via the display/user-interface 122 of the currency handling device 100. In still another alternative embodiment, no call bills and bills that are stacked upon one another are directed to the second upper output receptacle 106b. In still another alternative embodiment, the operator can direct that all documents failing an authentication test be delivered to the first upper output receptacle 106a. In another alternative embodiment, the operator instructs the currency handling device 100 to deliver no call bills, suspect bills, stacked bills, *etc.* to one of the lower output receptacles 106c-106h. The currency handling device 100 which has eight output receptacles 106a-106h provides a great deal of flexibility to the user. And in other alternative embodiments of the currency handling device 100, numerous different combinations for processing documents are available.

According to one embodiment, the various operations of the currency handling device 100 are controlled by processors disposed on a number of printed circuit boards ("PCBs") such as ten PCBs located throughout the device 100. In one embodiment of the present invention, the processors are Motorola processors, model number 86HC16, manufactured by Motorola, Inc. of Schaumburg, Illinois. Each of the processors are linked to a central controller via a general purpose communications controller disposed on each PCB. In one embodiment of the present invention the communications controller is an ARCNET communications controller, model COM20020, manufactured by Standard Microsystems Corporation of Hauppauge, New York. The communications controller enables the central controller to quickly and efficiently communicate with the various components linked to the PCBs.

According to one embodiment, two PCBs, a "motor board" and a "sensor board," are associated with each pair of lower output receptacles 106c-106h. The first two lower output receptacles 106c,d, the second two lower output receptacles 106e,f, and the last two lower output receptacles 106g,h are paired together. Each of the lower output receptacles 106 contain sensors which track the movement of the bills into the lower output receptacles 106c-106h, detect whether each storage cassette 118a-118e is positioned within the currency handling device 100, detect whether the doors 359 of the storage cassettes 118 are opened or closed, and whether the cassettes 118 are full. These aforementioned sensors associated with each pair of the lower output receptacles are tied into a sensor board which is linked to the central controller. The operation of the plunger assembly 300, the stacker wheels 202, the portion of transportation mechanism 104 disposed above the lower output receptacles 116c-116h, and the diverters 130 are controlled by processors disposed on the motor board associated with each pair of lower output receptacle's 106c-106h. Those sensors 130 which track the movement of bills along the transportation mechanism 104 that are disposed directly above the lower output receptacles 106c-106h are also tied into the respective motor boards.

One of the four remaining PCBs is associated with the operation of the one or two stacker wheels 127 associated with the upper output receptacles 106a,b, the stripping wheels 140, the primary drive motor of the evaluation region 108, a diverter which direct bills to the two upper output receptacles 106a,b, and the diverter which then directs bills between the two upper output receptacles 106a,b. The remaining three PCBs are

associated with the operation of the transport mechanism 104 and a diverter which directs bills from the transport path to the bill facing mechanism 110. The plurality of sensors 130 disposed along the transport mechanism 104, used to track the movement of bills along the transport mechanism 104, also tied into these three remaining PCBs.

5 Referring now to FIGS. 19-22, a two belt bill facing mechanism 400 is illustrated. The two belt bill facing mechanism 400 is an alternative embodiment of the bill facing mechanism 110 referred to in FIGS. 1a and 1b and in the above related discussion. The two belt bill facing mechanism 400 can be used in conjunction with the currency handling device 100 shown in FIGS. 1a and 1b to rotate the orientation of a bill  
10 401 approximately 180°. For example, if a U.S. bill, for example, is initially presented with the surface bearing a portrait of a president facing down, it may be directed to the two belt bill facing mechanism 400, whereupon it will be rotated 180° so that the bill surface with the portrait faces up. The decision may be taken to send a bill 401 to the facing mechanism 400 when the selected mode of operation or other operator  
15 instructions call for maintaining a given face orientation of bills as they are processed by the currency handling device 100. For example, it may be desirable in certain circumstances for all of the bills ultimately delivered to the lower output receptacles 106c-106h to have the same face orientation. In such embodiments of the currency handling device 100, the bill evaluation region 108 is capable of determining the face  
20 orientation of a bill, such that a bill not having the desired face orientation can first be directed to the two belt bill facing mechanism 400 before being delivered to the appropriate lower output receptacle 106c-106h.

The two belt bill facing mechanism 400 ("facing mechanism") includes a first belt 402 and a second belt 404. Each of the first and the second belts 402,404 forms a  
25 continuous loop. The belts 402,404 are disposed adjacent to each other such that the opposing surfaces of each belt 402,404 forms a bill facing transport path 406. The belts 402, 404 are twisted together so that an inlet 408 of the transport path 406 is rotated approximately 180° with respect to an outlet 410 of the transport path 406.

The first and second belts 402, 404 are each wrapped around two rollers. The  
30 first belt 402 is positioned around a first roller 412 disposed adjacent the inlet 408 and a second roller 414 disposed adjacent the outlet 410. The second belt 404 is positioned around a third roller 416 disposed adjacent the inlet 408 and a fourth roller 418 disposed



adjacent the outlet 410. As illustrated in FIG. 19, the first and second rollers 412,414, associated with the first belt, are positioned such that the first roller 412 is the “top” roller at the inlet 408 and the second roller 414 is the “bottom” roller at the outlet 410. The third and forth rollers 416,418, associated with the second belt, are positioned such that the third roller 416 is the “bottom” roller at the inlet 408 and the forth roller 418 is the “top” roller at the outlet 410. This arrangement allows the for the “twisted” bill facing mechanism transport path 406. Starting from the inlet 408, a first end 402a of the first belt 402 is placed around the first roller 412 which is disposed above the third roller 416 around which a first end 404a of the second belt 404 is placed. Viewing FIG. 19 from right to left, the first and the second belts 402,404 are together twisted 180° out of the page. The second end 404b of the second belt 404 is now disposed above the second end 402b of the first belt 402. The second end 404b of the second belt 404 is positioned around the forth roller 418 and the second end 402b of the first belt 402 is positioned around the third roller 414. Between the inlet 408 and the outlet 410, that is between the rollers, there is no structure supporting the portions of the first or the second belts 402,404 which define the bill transport path 406. The rollers are connected to shafts 419 about which the rollers rotates. In one embodiment of the two belt bill facing mechanism, the rollers 414,418 are driven rollers and the rollers 412,416 are passive rollers. In such an embodiment, a motor (not shown) is coupled to the shafts 419 associated with driven rollers 414,418.

Two belt guides 420 (FIGS. 19 and 20) are used to guide the portion of the belts not defining the transport path 406 or the return portion 422 of the belts away from the transport path. The return portion 422 of the belts 402,404 is drawn away from the transport path 406 to insure that the return portion 422 does not contact a bill 401 traveling along the transport path 406 causing the bill 401 to become skewed relative to the transport path 406. Each belt guide 420 is attached to a structure 424 which is fixed to the currency handling device 100. In FIGS. 19 and 20, only the first belt guide 420 is clearly illustrated. In the illustrated embodiment, each belt guide 420 includes one vertical roller and two horizontal rollers 426. The vertical roller associated with the second belt guide 420 is labeled with reference number 427. The interior of each belt 402,404 travels against the vertical roller. Any vertical movement of the return portion 422 of the belt is constrained by the two horizontal rollers 426 along which the edges

428,429 of the belts 402,404 travel. In an alternative embodiment, the belt guide 420 only contains one horizontal roller 426 to limit the vertical movement of the return portions of the belts.

In the embodiment illustrated in FIG. 20, the two belt bill facing mechanism contains belt end guides 440. The belt end guides 440 are used to maintain the position of belts 402,404 on rollers 412, 416. The belt guides limit any horizontal movement of the belts 402, 404 at their first ends 402a,404b. In another embodiment of the two, belt bill facing mechanism two more belt end guides are used to limit any horizontal of the belts 402,404 at the second ends 402b,404b. The belt end guides 440 consists of a structure 442 and two rollers 444. Because the belt guides 420 pull the return portion 422 away from the transport path 406, the belt guide rollers 444 maintain the belt ends on the rollers 412, 414, 416, 418 and prohibit any movement of the belts 402,404 off of the rollers 412, 414, 416, 418.

The bill facing mechanism 400 also contains four guides 431,432,433, 434 disposed along the bill transport path 406. Each of these guides are also fixed to the structures 424. The guides 431-434 are made out of a rigid material. A bill is transported through the bill facing mechanism (as well as the through the transport mechanism 104 of currency handling device 100) with the leading edge of the bill being the long or wide edge of the bill 401. The width of the bill 401 is greater than the width of the first and the second belts 402,404 causing a significant portion of the bill 401 to overhang each edge of the belts 402,404. The function of the guides is to provide support to those portions of the bill 401 which overhang the belts 402,404. Because of the high processing rate at which the currency handling device 100 operates, a significant angular velocity is imparted to a bill directed through the facing mechanism. In alternative embodiments of the currency handling device 100, bills are processed at speeds in excess of 1200 bills per minute. The differences in air pressures acting on the front and the back surfaces areas of the bill 401 can cause the bill 401 to fold or be forced such that the bill is no longer being transported in a substantially flat manner. This situation can occur more readily when the bill stiffness is degraded due to bill wear resulting from heavy usage. Additionally, bills are often folded in a variety of manners which may cause a bill to be biased in a certain direction such that the bill will not lie flat under its own weight. It is preferable for the bill 401 to be transported through the bill

facing mechanism 400 (and the currency handling device 100) in a substantially flat manner. If the bill 401 is not substantially flat when traveling from the outlet 410 of the bill facing mechanism 400 back into the bill transport mechanism 104 there is a possibility that the bill may become skewed at the interface between the outlet 410 and the transport mechanism 104 because the transport mechanism 104 may not "catch" the entire leading edge of the bill.

In operation, a bill 401, shown in position E, enters the inlet 408 of the bill facing mechanism 400 and is transported along the bill facing transport path 406 in a direction from right to left indicated by arrow D. The bill 401 adjacent to the outlet 410 is shown in position F which is a 180° rotation from position E. Referring to the bill 401 in position E, the bill 401 has narrow edges 450,451 and surfaces 452, 453. The first and second belts 402,404, a portion of which define the transport path 406, are twisted causing the bill 401 to rotate in manner such that the (near) edge 450 of the bill 401 drops into the page and the (far) edge 451 of the bill 401 rotates up and out of the page. As the bill 401 travels through the bill transport path 406, the surface 452 towards the (near) edge 450 of the bill 401 is guided by the first guide 431. The surface 453 towards the (far) edge 451 of the bill 401 is supported by the second guide 432. The guides 431,432 support their respective surfaces of the bill 401 until the bill 401 is substantially in a vertical position. As the bill continues to travel towards the outlet 410 the edge 451 (now at the top of the page) continues to rotate out of the page while the edge 450 (now at the bottom of the page) rotates into the page. Continuing, the surface 453 towards the edge 451 is being guided by the guide 433. The surface 452 towards edge 450 is being guided by the guide 434. When the bill arrives at the outlet 410, the orientation of the bill has been rotated 180°. The bill then merges into the transport mechanism 104 of the currency handling device 104.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and herein described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

**CLAIMS:**

1. An apparatus for rotating the orientation of a bill approximately 180°, the apparatus comprising:

5 a first belt having a bill transport portion and a return portion, the first belt having a first end and second end, the second end of first belt being twisted approximately 180° in relation to the first end of the first belt;

a second belt having a bill transport portion and a return portion, the second belt having a first end and second end, the bill transport portion of the first belt being disposed adjacent to the bill transport portion of the second belt, the second end of  
10 second belt being twisted approximately 180° in relation to the first end of the second belt;

a bill transport path being defined by the bill transport portions of the first and the second belts, the bill transport path having an inlet and an outlet, wherein the outlet of the bill transport path is twisted approximately 180° in relation to the inlet; and

15 a plurality of guides disposed adjacent to the bill facing path, the plurality of guides being adapted to support the outer portions of the bill which extend beyond a width of the first and the second belts as the bill is being transported along the transport path.

20 2. The apparatus of claim 1 further comprising a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers.

25 3. The apparatus of claim 2 further comprising a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the second pair of rollers.

30 4. The apparatus of claim 1 further comprising a first belt guide being adapted to guide the return portion of the first belt away from the transport path.

5. The apparatus of claim 4 further comprising a second belt guide being adapted to guide the return portion of the second belt away from the transport path.

6. The apparatus of claim 1 wherein the first belt comprises a continuous loop.

7. The apparatus of claim 6 wherein the second belt comprises a continuous loop.

8. An apparatus for rotating the orientation of a currency bill approximately 180°, the apparatus comprising:

a bill transport path having an inlet and an outlet, the transport path being adapted to transport the bill from the inlet to the outlet, the transport path being defined by opposing surfaces of a first and a second belt, the first and second belts each having a first and a second end, the second end of the first and second belts being twisted approximately 180° in relation to the first end of the first and second belts, wherein the inlet of the transport path is rotated approximately 180° in relation to the outlet;

a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers; and

a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the first pair of rollers.

9. The apparatus of claim 8 wherein the first belt includes a return portion, the apparatus further comprising a first belt guide being adapted to guide a portion of the first belt not defining the bill transport path away from the transport path.

10. The apparatus of claim 9 wherein the second belt includes a return portion, the apparatus further comprising a second belt guide being adapted to guide a portion of the second belt not defining the bill transport path away from the transport path.

11. The apparatus of claim 8 wherein the first belt forms a continuous loop.

12. The apparatus of claim 11 wherein the second belt forms a continuous  
5 loop.

13. An apparatus for rotating the orientation of a currency bill approximately  
180° comprising:

a first and a second belt having a first end and a second end, each of the first and  
10 the second belts forming a continuous loop, each of the first and the second belts having  
an inner and an outer surface, the first belt being disposed adjacent to the second belt  
wherein a portion of the outer surfaces of the first and second belts define opposing  
surfaces of a bill facing path, the bill facing path having an inlet corresponding to the  
first end of the first and the second belts and an outlet corresponding to the second ends  
15 of the first and the second belts, the first and the second belts being twisted together  
causing the second ends of the first and second belts to be twisted approximately 180°  
with respect to the first ends of the first and the second belts causing the outlet of the bill  
facing path to be twisted approximately 180° with respect to the inlet;

a plurality of guides disposed adjacent to the bill facing path, the plurality of  
20 guides being adapted to support the outer portions of a bill which extend beyond a width  
of the first and the second belts as the bill is being transported along the transport path;

a first pair of rollers, one of the first pair of rollers being disposed adjacent the  
inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt  
being disposed around the first pair of rollers; and

25 a second pair of rollers, one of the second pair of rollers being disposed adjacent  
the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the  
second belt being disposed around the first pair of rollers.

14. The apparatus of claim 13 further wherein the first belt includes a return  
30 portion, the apparatus further comprising a first belt guide being adapted to guide the  
return portion of the first belt away from the transport path.

15. The apparatus of claim 14 further wherein the second belt includes a return portion, the apparatus further comprising a second belt guide being adapted to guide the return portion of the second belt away from the transport path.

- 5 16. A currency evaluation device for receiving a plurality of currency bills and rapidly evaluating each of the bills, the device comprising:
- an input receptacle being adapted to receive a plurality of bills to be evaluated;
  - one or more output receptacles adapted to receive the bills after the bills have been evaluated, at least one of the output receptacles having a first compartment and a  
10 second compartment, the output receptacle having a gate disposed between the first compartment and the second compartment, the gate having an open position and a closed position, the gate being adapted to form a bill supporting surface when in the closed position, the gate having at least one lever outwardly extending therefrom, the lever being in a first position when the gate is in the closed position and the lever being in a  
15 second position when the gate is in the open position;
  - a transport mechanism being adapted to transport the bills, one at a time along a transport path, from the input receptacle to the first compartment of one of the output receptacles;
  - a bill facing mechanism disposed along the transport path between the input  
20 receptacle and the output receptacles, the bill facing mechanism including a first and a second belt having a first end and a second end, each of the first and the second belts forming a continuous loop, each of the first and the second belts having an outer surface, the first belt being disposed adjacent to the second belt wherein a portion of the outer surfaces of the first and second belts define a bill facing path, the bill facing path having  
25 an inlet corresponding to the first end of the first and the second belts and an outlet corresponding to the second ends of the first and the second belts, the first and the second belts being twisted together causing the second ends of the first and second belts to be twisted approximately 180° with respect to the first ends of the first and the second belts causing the outlet of the bill facing path to be twisted approximately 180° with  
30 respect to the outlet of the bill facing path, the bill facing mechanism including a plurality of guides disposed adjacent to the bill facing path, the plurality of guides being

adapted to support the outer portions of the bill which extend beyond a width of the first and the second belts as the bill is being transported along the transport path;

an evaluating unit being adapted to determine information concerning the bills, the evaluation unit having at least one sensor positioned along the transport path between the input receptacle and the output receptacles;

an operator interface being adapted to receive operational instructions from a user and to display the information concerning the bills; and

a controller being adapted to couple the operator interface and the evaluation unit, the controller causing the discriminating unit to operate in one of a plurality of operating modes which determine into which output receptacle each bill is delivered in response to the operational instructions from the user.

17. The device of claim 16 wherein the first belt includes a return portion, the apparatus further comprising a first belt guide being adapted to guide the return portion of the first belt away from the transport path.

18. The device of claim 17 wherein the second belt includes a return portion, the apparatus further comprising a second belt guide being adapted to guide the return portion of the second belt away from the transport path.

19. The device of claim 16 further comprising a first pair of rollers, one of the first pair of rollers being disposed adjacent the inlet, the other of the first pair of rollers being disposed adjacent the outlet, the first belt being disposed around the first pair of rollers.

20. The device of claim 19 further comprising a second pair of rollers, one of the second pair of rollers being disposed adjacent the inlet, the other of the second pair of rollers being disposed adjacent the outlet, the second belt being disposed around the first pair of rollers.



**ABSTRACT**

An apparatus for rotating a bill approximately 180° comprising a first and a second belt. The first belt has a bill transport portion, a return portion, a first end, and a second end. The second end of first belt being twisted approximately 180° in relation to the first end of the first belt. The second belt has a bill transport portion, a return portion, a first end, and second end. The bill transport portion of the first belt is disposed adjacent to the bill transport portion of the second belt. The second end of second belt is twisted approximately 180° in relation to the first end of the second belt. A bill transport path is defined by the bill transport portions of the first and the second belts. The bill transport path has an inlet and an outlet. The outlet of the bill transport path is twisted approximately 180° in relation to the inlet. A plurality of guides are disposed adjacent to the bill facing path for supporting the outer portions of the bill which extend beyond a width of the first and the second belts as the bill is being transported along the transport path.

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